AD-A155 635 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/2
INDIAN LAKE DAM (MA 0..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV DEC 79

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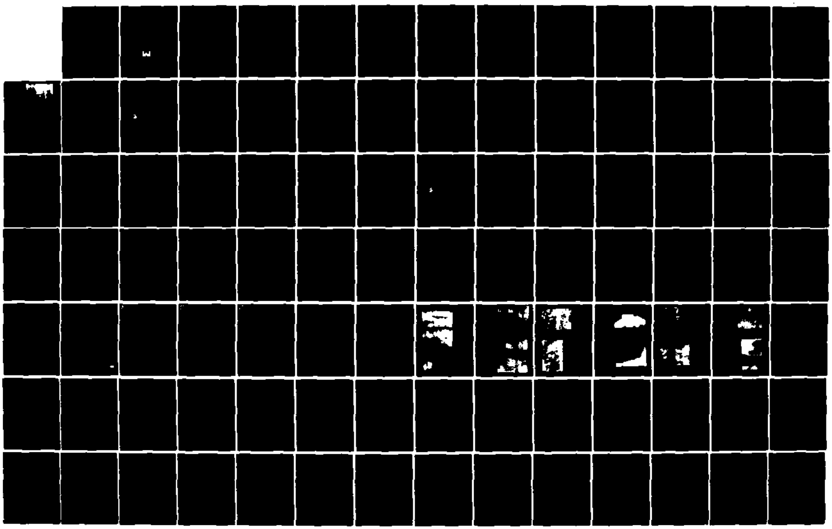

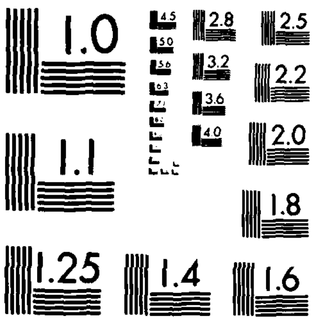

AD-A155 635

CONNECTICUT RIVER BASIN
BECKET, MASSACHUSETTS

INDIAN LAKE DAM
MA 01051

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

DECEMBER 1979

REPRODUCED AT GOVERNMENT EXPENSE

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4. TITLE (and Subtitle) Indian Lake Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin
Becket, Massachusetts
Spark Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is an earth embankment about 460 ft. long with a height of about 15 ft. above the brook channel. The embankment is in fair condition. It is small in size with a hazard potential of high. Some leakage is apparently occuring under the embankment, but does not appear to be hazardous.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

AUG 11 19[illegible]

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Indian Lake Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, Community Savings Bank, 200 Main Street, Holyoke, Massachusetttts 01040.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

INDIAN LAKE DAM

MA 01051

CONNECTICUT RIVER BASIN
BECKET, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	MA 01051
Mass. DPW No.:	1-2-22-17
Name of Dam:	Indian Lake Dam
Town:	Becket
County and State:	Berkshire County, Massachusetts
Stream:	Spark Brook
Date of Inspection:	October 31, 1979

BRIEF ASSESSMENT

Indian Lake Dam is located on Spark Brook, a tributary of Walker Brook which joins the West Branch of the Westfield River at Chester, Massachusetts. The dam is an earth embankment about 460 feet long with a height of about 15 feet above the brook channel. Near the center of the embankment is a reinforced concrete gravity wall spillway and control structure. The spillway is a free overfall straight drop type with a reinforced concrete, stone lined stilling basin and outfall channel, and provisions for flashboards or stop logs on the crest. A 30 inch square reservoir drain with hand operated sluice gate is also provided in the spillway structure.

The dam is owned by Community Savings Bank, Holyoke, Massachusetts. The dam was designed by Barnes & Jarnis Engineers, Inc., Boston, Massachusetts. The dam was built in 1974/1975 for recreational purposes. It has a tributary drainage area of 1.32 square miles and a maximum design storage capacity of 621 acre-feet.

The embankment is in FAIR condition. The embankment is not at design height and downstream embankment protection has not been provided. The spillway is in FAIR condition. The spillway structure shows signs of poor workmanship and deficiencies which could eventually create hazards. Some leakage is apparently occurring under the embankment, but does not appear to be hazardous.

The preliminary hydrologic and hydraulic tests for this SMALL size, HIGH hazard class dam indicate the spillway is adequate if properly operated. Due to the potential hazard to downstream highways and development in the Town of Chester, a one-half Probable Maximum Flood (½ PMF) was developed to test spillway capacity. The area tributary to the dam site is gently rolling upland about 95% covered with good forest and with a considerable area of swamp just above the reservoir to retard and reduce runoff. The rolling terrain curve for maximum probable flood was used and extrapolated to about 1.3 square miles. This indicated a peak flood flow of about 1125 cfs per square mile, or 1,300 cfs on this drainage area. Routing this flood flow through the reservoir starting at normal water level, but assuming that the flashboards would go out, the spillway would carry the estimated maximum outflow of 750 cfs with about 1.2 feet freeboard if the embankment is completed to design height.

It is recommended that the embankment be brought to design height and riprap placed on the downstream slope within the next year. Stop log guides should be modified so that only thinner flashboards can be inserted and so that the height above the concrete crest cannot exceed a pre-determined height. The left embankment drain should be inspected by excavating at various points along its length to ascertain the cause of its apparent malfunctioning. Inspection and maintenance should be performed on a regular basis at least annually.

John W. Powers
Massachusetts Registration 23106

This Phase I Inspection Report on Indian Lake Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dam for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environmental of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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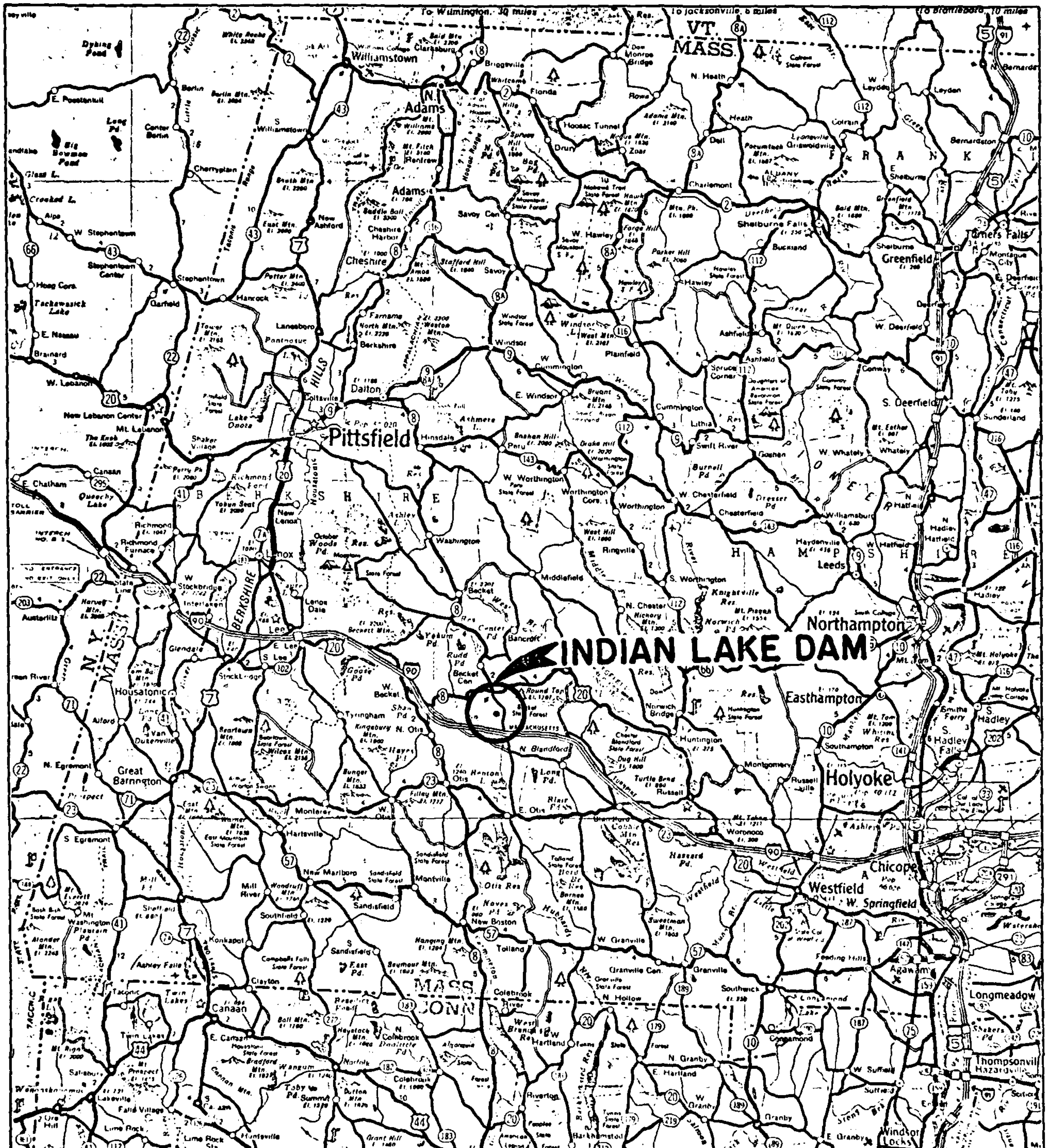
APPENDICIES



TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

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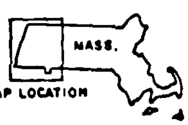
SCALE IN MILES



MAP LOCATION

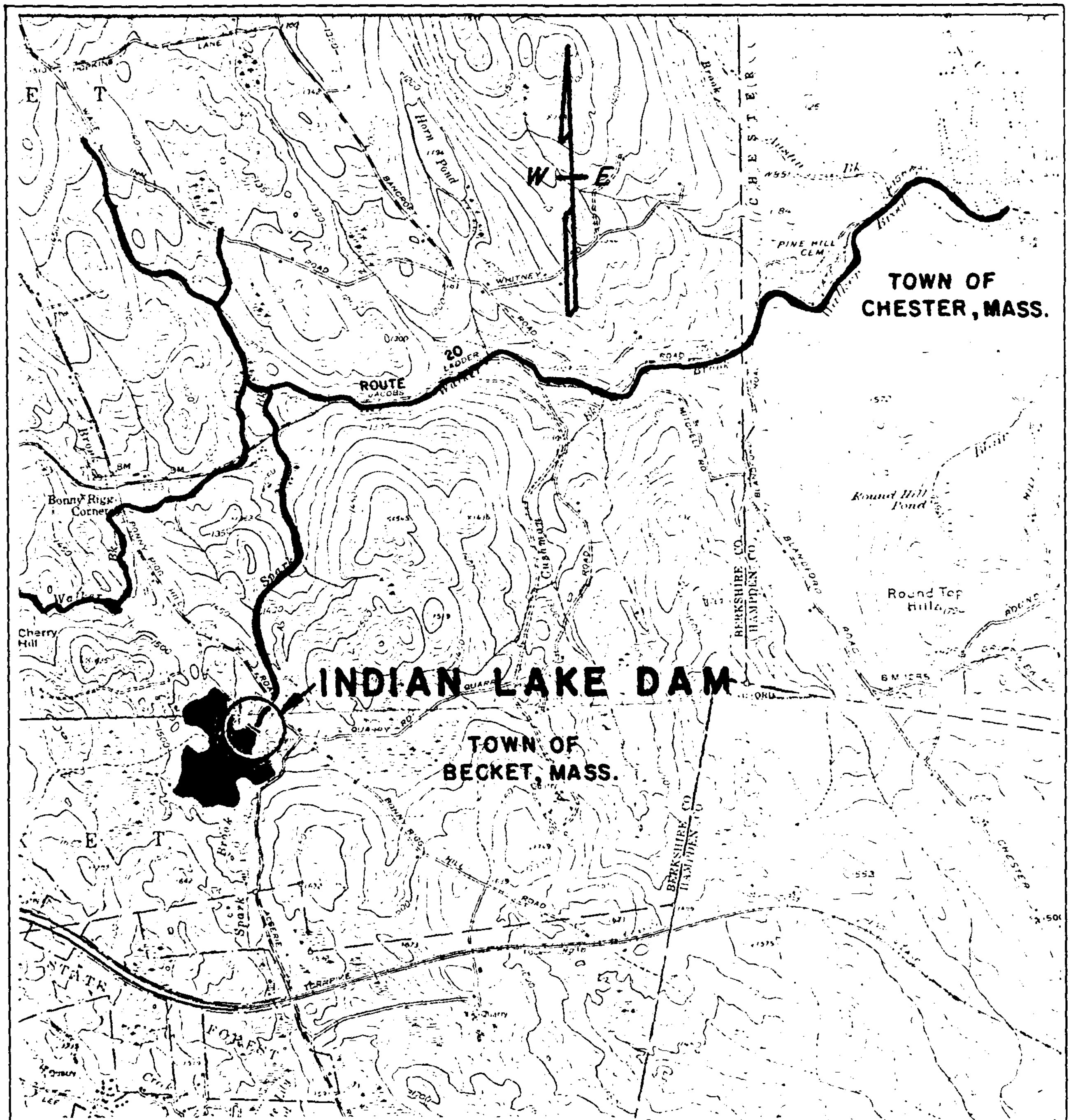
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCUS PLAN I

INDIAN LAKE DAM (MA 01051) BECKET
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: AS NOTED

DATE: DECEMBER 1979



- SCALE -

1000' 0' 1000' 2000' 3000' 4000'

FROM USGS OTIS
BECKET
CHESTER

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCUS PLAN 2

INDIAN LAKE DAM (MA 01051) BECKET
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: AS NOTED

DATE: DECEMBER 1979

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

INDIAN LAKE DAM

SECTION 1

PROJECT INFORMATION

1.1 General

(a) Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Tighe & Bond/SCI has been retained by the New England Division to inspect and report on selected dams in Massachusetts. Authorization and notice to proceed were issued to Tighe & Bond/SCI under a letter of October 24, 1979 from Colonel William E. Hodgson, Jr. Inc., Corps of Engineers. Contract No. DACW 33-80-C-0005 has been assigned by the Corps of Engineers for this work.

(b) Purpose

1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-federal dams.

3) Update, verify, and complete the National Inventory of Dams.

(c) Scope

The program provides for the inspection of non-federal dams in the high hazard potential category based upon location of the dams, and those dams in the significant hazard potential category believed to represent an immediate danger based on condition of the dams.

1.2 Description of Project

(a) Location

Indian Lake dam is located on Spark Brook about 8,000 feet upstream of its confluence with Walker Brook which flows into the

West Branch of the Westfield River at Chester, Massachusetts about 3.8 miles downstream from the Spark Brook confluence. This dam is about 600 feet to the west off Bonny Rigg Hill Road at a point about 1.1 miles south of U.S. Route 20 at Bonny Rigg Corners, which is about 4.6 miles west along Route 20 from Chester, Massachusetts. The dam site is shown on the U.S.G.S. Otis, Mass. qradrangle at longitude N42°-14'-57" and latitude W73°-01'-27". (See locus plans)

(b) Description of Dam and Appurtenances

The dam consists of an uncompleted earth embankment about 460 feet long with impervious seal at upstream toe and height above streambed of about 15 feet. Near the center of the embankment is a reinforced concrete spillway and control structure.

1) Embankment

The embankment is a zoned compacted earthfill embankment. The principal embankment material used for impervious and toe seal is local glacial till placed wet of optimum. Clean sandy gravel was used for foundation replacement of peat in the swamp area, for bedding for rock riprap, and for embankment crest. Random granular borrow was used to build the downstream shell. Heavy dumped rock riprap provides upstream slope protection from below minimum water level to top of embankment. Loam to finish and protect the top of the embankment and the downstream slope is stockpiled on the downstream slope but has not been spread and seeded. Peastone pockets have been provided around the 6" ACCMP foundation drains. The embankment is founded on very firm glacial till.

The top of the embankment is about 14 feet wide but has not been completed to full height; it is about 1.1 feet below spillway abutment top for about 200 feet of the embankment length. Embankment side slopes, both upstream and downstream, are 2½ horizontal to 1 vertical. In areas where peat was removed, it was replaced with gravel and an impervious zone seal was placed upstream of the gravel foundation extending from the glacial till embankment body down to the till foundation and as much as 18 feet wide.

The right or southeast embankment crosses a low ridge which has been excavated to assure that surface drainage from the downstream face will flow to the brook some distance from the embankment toe.

2) Spillway

The spillway and reservoir drain are located in a reinforced concrete structure near the right or southeast side of the valley bottom. The reservoir drain is a 30 in. x 30 in. sluice way at the left, northwesterly, bay of the spillway. It

is closed by a manually operated sluice gate with invert at about the level of the old stream bed.

The spillway is a broad crested free overfall type with straight drop to the reinforced concrete stilling basin which is lined with heavy riprap rock. The spillway wall is vertical between piers and provides three 5'-4" clear width bays. Above the vertical faced reinforced concrete spillway crest the piers are fitted with steel stop log channels 4 3/4 inches wide and 2 inches deep.

Provisions have been made for a steel stringer and grating deck bridge for access to the stop logs. Also, provisions have been made for fencing on the top of the spillway side walls and wing walls. Neither the bridge nor the fence have been installed.

The entrance channel in front of the spillway base slab between and in front of the wing walls is lined with riprap. The outlet end of the stilling basin has a slotted end sill to contain riprap fill and assure a hydraulic jump before outflow enters the outlet channel. Inlet wing walls are at 60° to spillway channel axis; and outlet wing walls at 45° to channel axis. Spillway side walls and wing walls are cantilever retaining walls without weep holes.

(c) Size Classification

Dam size based on height of embankment is SMALL. Dam size based on maximum impoundment at design top of dam of 621 acre-feet is SMALL. The dam size rated by the Corps of Engineers Guidelines is SMALL.

(d) Hazard Classification

This dam, rated by the Corps of Engineers Guidelines, is classed as a HIGH hazard dam due to the potential loss of many lives in a seasonally densely populated campground and potential destruction of at least two year-round residences downstream of the dam along Walker Brook.

(e) Ownership

The present owner of the dam is:

Community Savings Bank
200 Main Street
Holyoke, Massachusetts 01040
Tel.: 413-536-7220

The original owner and builder of the dam was:

Mr. James F. Hansman
67 Harwich Road
West Springfield, Massachusetts 01089

(f) Operator

No day to day operator is known. The contact person for the owner is Mr. Agostino J. Calheno, Assistant Vice President, Community Savings Bank, Tel.: 413-536-7220; night Tel.: 413-532-7765.

(g) Purpose of Dam

The dam was built to provide a recreation pond for a planned vacation development. The developer went bankrupt and neither the dam nor the development was completed. The development is not occupied and the pond is not actively used. However, the reservoir is at about design normal water level.

(h) Design and Construction History

The dam was designed by Barnes & Jarnis, Inc., Engineers, 61 Batterymarch Street, Boston, Massachusetts. Site survey and layout services were provided by Gordon .E. Ainsworth & Associates, Land Surveyors, South Deerfield, Massachusetts. Haley & Aldrich, Inc., Consulting Soils Engineers, Cambridge, Massachusetts provided soils engineering services. Preliminary soil borings were taken by C.L. Guild Drilling and Boring Co., Inc., Braintree, Mass.; soil test pits were excavated under the supervision of Haley & Aldrich.

General contractor for the construction of the dam embankment was Andrews Construction Co., Washington Road, Washington, Mass. Concrete spillway construction was by Western Massachusetts Engineering Company, Lee, Mass. Construction was carried out between October 1974 and October 1975.

Plans and specifications for the dam were reviewed and approved by the Massachusetts Department of Environmental Quality Engineering, Division of Waterways. Site inspections by Division of Waterways' personnel were carried out both during and after construction.

Construction started in October 1974, Spark Brook was diverted to the left, or northwest, and most of the right or southeast embankment was completed during that fall. Excavation and embankment construction were inspected by Haley & Aldrich personnel.

Spillway construction was completed before August 5, 1975 when embankment construction was resumed and Spark Brook was diverted through the reservoir drain in the spillway structure. Construction was halted due to lack of payments about October 6, 1975 with a number of items still incomplete. It appears that no further construction work on the dam has been accomplished since then.

i) Normal Operating Procedure

Normally the dam would require no operation. The spillway allows excess water to overflow when fitted with proper flashboards. The normal pool level will be maintained by stream inflow with excess discharging over the spillway. In the event of excessive inflow, the flashboards should wash out, automatically increasing spillway capacity for emergency conditions.

1.3 Pertinent Data

(a) Drainage Area

The drainage area of this dam covers about 1.3 square miles. It is made up of rolling well forested uplands above 1400 feet elevation with few clearings. About 3,800 feet of the Massachusetts Turnpike, Route I-90, abuts or crosses the watershed. There are about 41 acres of low level swamps making up about 5 percent of the watershed. Much of this is low in the watershed, only slightly above maximum reservoir elevation.

(b) Discharge at Dam Site

1) Outlet Works

Normal discharge at the site is over the spillway crest. The crest of the reinforced concrete spillway wall is at elevation 1,473.0 MSL. The crest is fitted to allow installation of stop logs or flashboards to elevation 1,478.5 NGVD. The top of the reinforced concrete spillway sidewall is 1,480.0 NGVD. This is the same elevation as the design crest of the embankment. The top of the embankment is now at elevation 1,478.9 NGVD.

A reservoir drain is also located in the concrete spillway structure. It is a 30 in. x 30 in. sluice way with a manually operated sluice gate. Sluice gate invert is 1465.6 NGVD. Maximum drain capacity is about 127 cfs.

1) Outlet works (reservoir drain) - 30" x 30"
Sluice way: Discharge capacity - 120 cfs

2) Maximum Known Flood at dam site - Unknown

2) Maximum Known Flood

Maximum known flood at the dam site is of unknown magnitude.

3) Ungated Spillway Capacity at Top of Dam

The capacity of the spillway above the normal elevation of the stop logs (1,475.0 feet NGVD) to the top of the

existing embankment (1,478.9 feet NGVD) is 410 cfs.

The capacity of the spillway above the normal elevation of the stop logs (1,475.0 feet MSL, NGVD) to the top of the embankment as designed (1,480.0 feet NGVD) is 595 cfs.

4) <u>Ungated Spillway Capacity at Test Flood</u>

The capacity of the spillway above the normal elevation of the stop logs (1475.0 feet MSL, NGVD) to the test flood elevation (1478.8 feet MSL, NGVD) is 395 cfs.

5) <u>Gated Spillway Capacity at Normal Pool</u>

The capacity of the spillway with no stop logs (1,473.0 feet MSL, NGVD) and embankment at present elevation (1,478.9 feet NGVD) is 765 cfs.

The capacity of the spillway with no stop logs (1,473.0 feet MSL, NGVD) and embankment at design elevation (1,480.0 feet NGVD) is 987 cfs.

6) <u>Gated Spillway Capacity at Test Flood</u>

The capacity of the spillway with no stop logs (1473.0 feet MSL, NGD) at the test flood elevation (1478.8 feet MSL, NGVD) is 750 cfs.

7) <u>Total Spillway Capacity at Test Flood</u>

The total spillway capacity at test flood (1,478.8 feet MSL, NGVD with no flashboards on the fixed crest (1,473.0 feet MSL, NGVD) is 750 cfs.

8) <u>Total Project Discharge at Top of Dam</u>

Total project discharge with no flashboards above spillway fixed crest elevation (1,473.0 feet MSL, NGVD), embankment top at present elevation (1,478.9 feet MSL, NGVD), and reservoir drain open is 886 cfs.

Total project discharge with no flashboards above spillway fixed crest elevation (1,473.0 feet NGVD), embankment at design height (1,480.0 feet NGVD) and reservoir drain open is 1,114 cfs.

9) <u>Total Project Discharge at Test Flood</u>

Total project discharge with no flashboards above spillway fixed crest elevation (1,473.0 feet NGVD), reservoir drain open and pond at test flood elevation (1478.8 feet NGVD) is 870 cfs.

(c) <u>Elevation</u> (feet above MSL, NGVD)

1) Streambed at toe of dam: 1465±

2) Bottom of cutoff: 1457±

3) Maximum tailwater: Unknown

4) Design Recreation pool: 1,475.0

5) Full flood control pool: N/A

6) Spillway crest:

a) Pond drain inlet: 1,465.6

b) Fixed concrete spillway: 1,473.0

c) Stop log slot top: 1,478.5

7) Design surcharge: 1,477

8) a) Top of dam designed: 1,480.0

b) Top of dam as found: 1,478.9

9) Test flood surcharge: 1,478.8

(d) <u>Reservoir</u> (Length in feet)

1. Design recreation pool: 2,250'

2. Flood control pool: Not applicable

3. Spillway crest pool: 2,000'

4. Actual Top of Dam: 2,350'

5. Design Top of Dam: 2380

5. Test flood surcharge: 2,350'

(e) <u>Storage</u> (acre-feet)

1. Design recreation pool: 256

2. Flood control pool: Not applicable

3. Spillway crest pool: 148

4. Test flood pool: 528

5. Actual Top of dam: 539

6. Design top of dam: 621

(f) Reservoir Surface (acres)

1. Design recreation pool: 62 acres

2. Flood control pool: Not applicable

3. Spillway crest pool: 46.2 acres

4. Test flood pool: 76 acres

5. Actual Top of dam: 76 acres

6. Design top of dam: 80 acres

(g) Dam

1. Type: Rolled earth embankment

2. Length: 460± ft.

3. Height: 15± ft.

4. Top width: 14 ft.

5. Side slopes: Upstream: 2.5 to 1
downstream: 2.5 to 1

6. Zoning: Impervious glacial till core
Sandy gravel foundation
Random granular downstream shell
Embankment drain of pea-gravel
Riprap wave zone

7. Impervious core: Glacial till placed wet of optimum

8. Cutoff: Glacial till placed wet of optimum where gravel foundation was placed

9. Grout curtain: None

(h) Diversion and Regulating Tunnel

Not applicable

(i) Spillway

1. Type: Free overfall, reinforced concrete, broad crested weir

2. Length of weir: 16 feet

3. Crest elevation:

   1. No flashboard or stop log: elev. 1473.0 MSL

   2. Max. flashboard or stop log: elev. 1478.5 MSL

4. Gates: one 30" x 30" manual vertical lift drain sluice gate
   Stop logs: 3 bays 5'-4" clear opening by 5.50' high

5. Upstream channel: Riprap lined channel in reservoir for 50 feet beyond spillway foundation and wing walls

6. Downstream channel: Riprap lined reinforced concrete stilling basin and riprap lined transition to outflow channel

(j) <u>Regulating Outlet</u>

1. Flashboards regulate pond elevation

   a. Invert: elev. 1,473.0 MSL

   b. Size: Length: 3 bays of 5'-4"=16.0 feet total
      Height: up to 5.5'

   c. Description: Steel edged slots 4 3/4 in. wide x 2 in. deep are provided in each pier from top of spillway crest (elev. 1,473.0 ft. MSL) to catwalk bridge seats (elev. 1,478.5 feet MSL)

   d. Control mechanism: Flashboards or stop logs are placed in the slots across each spillway opening manually as desired. Removal is also manual

2. Reservoir drain:

   a. Invert: elev. 1,465.6 MSL

   b. Size: 30 in. x 30 in.

   c. Description: Rodney Hunt HyQ rising stem sluice gate

   d. Control mechanism: Hand operated geared lift stand on bracket on spillway wall

SECTION 2 - ENGINEERING DATA

2.1 Design Data

To the best of our knowledge, design data in addition to that appearing on the plans and specifications furnished to the Massachusetts Division of Waterways is available at the offices of Barnes & Jarnis, Inc., Boston, Mass.

2.2 Construction Data

Construction inspection memos and reports are available at the offices of Haley & Aldrich, Inc., Cambridge, Mass.

"As built" plans are available from the Massachusetts Division of Waterways.

2.3 Operational Data

No operational data is available as the dam is self regulating.

2.4 Evaluation of Data

(a) Availability

Sufficient data is available to permit adequate evaluation of the dam when combined with visual inspection observations. Construction notes and memos did not reveal anything that would explain the lack of flow from the left foundation drain.

(b) Adequacy

There is sufficient design and construction data to permit an assessment of dam safety when combined with visual inspection observations, inspection reports and sound engineering judgment.

(c) Validity

Since visual inspection observations generally confirm the available data, it is considered valid.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

(a) General

Indian Lake Dam, MA 01051, was in FAIR condition at the time of the inspection.

(b) Dam

The earth embankment was found to be incomplete. The southeast (right) end is about 1.1 feet lower than top of spillway structure for a distance of about 117 feet. The northwest (left) end is about 1.1 feet lower than top of spillway structure and rises to a point about 52 ft. away where it is about 0.3 feet low.

Embankment top and downstream slope are unfinished and unprotected. Loam piles have been dumped at the toe of the slope. Minor erosion has developed on the downstream slope. Upstream riprap is satisfactory. Motorcycle tire tracks indicate trespass although there has been no serious damage.

Wet areas were found about 50 to 140 feet left of the spillway downstream from the toe of embankment. There were no "boil" spots or indications of "piping." The wet areas are considered to result from the use of gravel in the foundation beneath the impervious zone with only a thin cutoff seal at the upstream toe. The right foundation drain 30 minutes after being unclogged was flowing clear water - no sign of silt eroding into it. The left foundation drain was not flowing. There is no apparent reason why this drain should not have some flow since there was considerable wetness and minor surface ponding downstream from the toe of slope.

(c) Appurtenant Structures

The spillway structure was found to be in fair condition and functionally complete, although the spillway bridge and fencing have not been installed. The southeast side wall shows signs of a cold joint during concrete placing. There is efflorescence and seepage from this joint.

Stop logs were in place on the spillway crest raising the pool level to about 1.45 feet above the concrete crest. One base bolt for attaching the sluice gate lift stand to the base bracket was missing and one was corroded and obviously not of stainless steel construction.

(d) Reservoir Area

The reservoir shore appeared to be generally clear, gently sloping and stable. The reservoir is clear with little debris.

(e) Downstream Channel

The downstream channel is riprap lined for a short transition from the spillway and in satisfactory condition. The plunge pool of the spillway is rock lined and in good condition. The outflow channel is stable and satisfactory.

3.2 Evaluation

The dam is generally in FAIR condition. Deficiencies are as follows:

1. Embankment is 1.1' lower than design height.
2. Embankment top and downstream slope are unfinished; loam and seed were never placed.
3. The left foundation drain does not appear to be operating properly.
4. Access to the spillway for flashboard operation is incomplete.
5. The stop log guides will permit the use of heavy timber stop logs which would seriously reduce the capacity of the spillway if they did not washout in floods.
6. The stop log guides extend so high that spillway capacity can be dangerously inadequate if full height stop logs are installed.
7. The right foundation drain outlet was plugged at the time of our inspection; Tighe & Bond party unplugged this outlet.
8. Drain sluice gate lift stand mounting bolts are faulty.

SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

4.1 Operation Procedures

(a) General

No written operational procedures are available for this dam. The dam is normally self regulating. The sluice gate on the pond drain is normally in the closed position and is not routinely operated.

(b) Description of Warning System in Effect

There is no written warning system in effect.

4.2 Maintenance Procedures

(a) General

To the best of our knowledge, no routine maintenance procedures are in effect for this dam. There are no regular maintenance inspections of this dam by qualified personnel.

(b) Operational Facilities

The pond drain sluice gate is not, to the best of our knowledge, routinely operated.

Flashboard maintenance and/or routine inspection is non-existant.

There are no other facilities which require operation.

4.3 Evaluation

The condition of the dam and its appurtenances at the time of our inspection indicate a lack of maintenance.

A regular maintenance program would assist the owners in assuring the long term safety of this dam.

A formal, written downstream emergency flood warning system should be developed for this dam.

SECTION 5 - EVALUATION OF HYDRAULIC/ HYDROLOGIC FEATURES

5.1 General

Indian Lake Dam is located on Spark Brook about 8,000 feet (1.5 mi) above its confluence with Walker Brook at a point about 20,000 feet (3.8 mi) above the Village of Chester, Massachusetts at the confluence of Walker Brook and the West Branch of the Westfield River. The watershed above the dam has an area of about 1.3 square miles of gently rolling wooded uplands. The Massachusetts Turnpike crosses the upper end of the watershed. There are considerable swamp areas in the lower portions of the watershed above the reservoir.

Downstream of the dam the gradient of Spark Brook increases and it flows to Walker Brook. Walker Brook from the confluence with Spark Brook to the West Branch of the Westfield River parallels U.S. Route 20 through a steep, narrow gorge. The average slope of Spark Brook above the reservoir is about 95 feet per mile. The average slope of Spark Brook from the dam to Walker Brook is about 170 feet per mile. The average slope of Walker Brook below Spark Brook is about 160 feet per mile.

The spillway structure is constructed of reinforced concrete. The spillway is a free overfall concrete wall with a straight drop to a riprap lined reinforced concrete plunge basin.

5.2 Design Data

1. Spillway design data (from construction plans):

   Drainage area: 1.322 sq. mi. - 864 acres

   Flood: August, 1955

   Design Flood Reservoir Inflow : 1,415 cfs

   Design Flood Outflow with flashboards at normal water level: 120 cfs

   Maximum Water Level: 1,477.0 MSL

   Reservoir Normal Water Level: 1,475.0 MSL

   Storage Up To Normal Water Level: 255.8 ac. ft.

   Storage Normal W.L. to Flood W.L.: 140.1 ac. ft.

   Dam Top Elev.: 1,480.0 MSL

   Freeboard Above Maximum W.L.: 3.0 ft.

This data indicates that a design storm of high intensity but short duration and moderate to low runoff volume was assumed.

5.3 Experience Data

Reference: U.S.G.S. Water Supply Paper 1420
"Floods of August-October 1955"

Randomly selected data for locations in the same area as Indian Lake Dam were reviewed. Date is included in Appendix D.

Based on the 1955 flood report data, the design inflow peak and outflow peak are not unreasonable, but might be exceeded under some conditions.

5.4 Test Flood Analysis

The objective of the test flood analysis is to assess the capacity of the dam to safely pass a severe runoff event of a size commensurate with the size of the dam and the downstream hazard to life and property.

Guidelines for establishing a test flood are specified in "Recommended Guidelines" of the Corps of Engineers. Both the height of this dam (14.6 feet), which is less than 40 feet, and the storage volume at the top of the dam, (621 ac. ft.) which is less than 1,000 acre-feet, place this dam in the SMALL size class. The dam failure analysis indicated a potential for destruction of five year-round residences and much of a seasonally densely occupied campground with potential loss of more than a few lives making this a HIGH hazard class dam. Table 3 of the Corps of Engineers "Recommended Guidelines" recommends that the spillway test flood for a SMALL size, HIGH hazard class dam should be 1/2 probable maximum flood (PMF) to full PMF.

The 14.6 ft. height of this dam is substantially below the normal low limit of small dam size, indicating a test flood at low limit of recommended test flood range. The 621 acre feet maximum storage capacity is near the middle of the small size storage range indicating a test flood of about mid range. The watershed characteristics of good forest cover, low to moderate slopes in the "rolling" range, and swamps and low lands indicate a relatively slow and small storm runoff. For these reasons a test flood of ½ PMF reduced for watershed conditions has been adopted.

The spillway test flood was determined by extrapolating the "rolling" curve of "Maximum Probable Flood Peak Flow Rates" to the Indian Lake drainage area of 1.32 square miles. Half the discharge rate of 2250 cfs per square mile times 1.32 square miles area gives a peak flow of 1,485 cfs.

The PMF was reduced to allow for good forest cover, gently rolling slopes, and upstream swamps. 1266 cfs was taken as the peak inflow. Runoff volume was taken as 19/2 = 9.5 inches. This was routed through the reservoir starting with the reservoir at design normal water level (elev. 1,475.0 MSL). This limits reservoir storage for flood routing purposes to that above elev. 1,475.0 MSL.

Spillway capacity was calculated assuming behavior as a sharp edged rectangular weir with supressed end contractions and of sufficient height to discharge the outflow flood above the crest elevation of 1,473.0 MSL. Reservir drain sluice gate was assumed to be closed.

Though the first trial discharge height was above design top of dam, the final reservoir elevation was below design top of dam. Thus, it is appropriate to consider the routing characteristics using the discharge characteristics of the spillway only without introducing the altered characteristics of flow over the dam which would not occur under assumed conditions.

This PMF routing by the approximate methods suggested indicates that the PMF would fail to overtop the dam by about 1.2 feet if the embankment is at design height. Though the dam embankment is about 1.1 feet below design height, the dam as it stands would not be overtopped.

5.5 Dam Failure Analysis

The hazards and potential damages resulting from failure of Indian Lake Dam were evaluated based on conditions that would exist during a storm of the magnitude of the spillway test flood (½ PMF) just prior to dam failure and when the dam failure flood wave occurred in addition to the prior flood on the drainage basin. The procedures of "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs" by New England Division, Corps of Engineers, were used.

The dam was assumed to fail at maximum stage determined by the spillway test flood analysis, elev. 1478.8 MSL, NGVD. This elevation was used to determine volume of the flood wave (528 acre-feet) and height from river bed to pool level at failure (13.2 feet). The length of the dam was taken along centerline of construction at mid height (elev. 1472.8 MSL, NGVD) between river bottom at dam and design top of dam from original ground surface at one end to original ground surface at the other end. Breach width was taken as 40 percent of mid height length less spillway width. This analysis gave a peak dam failure flood wave discharge of 7515 cfs.

River stages were determined for a typical section of each reach. The PMF was determined for the entire tributary drainage area above each point of analysis including the area tributary to the dam. River stage was determined for the flow resulting from ½ PMF on the tributary area below the dam plus flow at the dam; i.e. spillway flow for test flood or dam failure flow as attenuated along the river.

Damage at centers 1, 2, and 3 is likely to occur as a result of dam failure flow of 7515 cfs at river stages about four (4) feet higher than flood stage, but not due to the storm flood flow of about 750 cfs. Damage would probably amount to road washout, as there are no houses along the stream above damage center 4. At damage center 4 the road would probably be washed out as a result of the storm flood, but the nearby house is about eight (8) feet above the road and is not likely to be damaged by storm flood or dam failure. At damage center 5 the road and the nearby house both would be damaged by the storm without

dam failure. At Blandford Pond, damage center 6, the road and one house would probably be washed out by the strom flood. One additional nearby house would probably be damaged by dam failure.

At the Walker Island Campground, damage center 7, the main road, Route 20, would probably not be damaged but the local road and much of the campground and the permanent house would be damaged by the storm flood of 13,000 cfs and river stage about 7 feet deep. Little additional damage caused by dam failure flow of 18,400 cfs which would add about one (1) foot to river stage because camp sites are at two elevations separated by 10 to 15 ft. high river banks.

At damage center 8, near the town road bridge, the storm flood of about 14,000 cfs and ten (10) feet deep river stage, would probably wash out the road and two low lying houses. Other houses in the area are 10 to 15 feet above the road and would not be damaged by dam failure flow of 19,000 cfs which would add about two (2) feet to river stage.

Along Walker Brook in the Village of Chester, damage center 9, there are a number of houses within sight of the brook and more houses and business buildings along Main Street, Route 20, that would be damaged, along with road wash out by the storm flood flow of 14,000 cfs and river stage of about ten feet. Only a couple additional houses would be affected by dam failure flow of about 18,700 cfs which would add about half a foot to river stages. Other houses are higher up hillside above the river and roads.

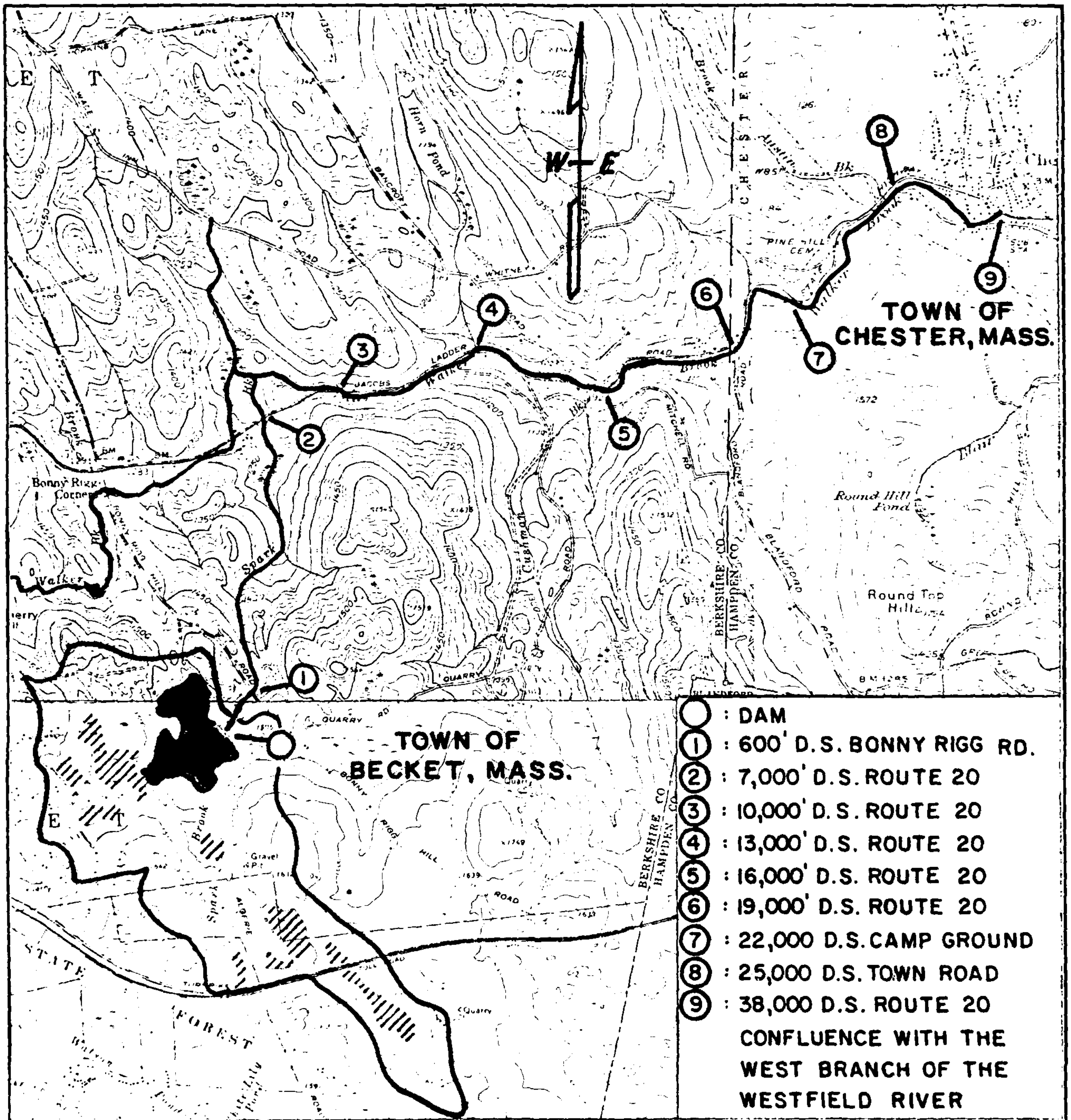
Flood walls and channel improvements along the Westfield River are adequate for floods of about the magnitude of ½ PMF,, 35,000 cfs and river stage of about 13.5 feet. The additional stage due to dam failure, about 4,700 cfs and about 0.7 feet, would probably not overtop the flood protection system in the Town.

In summary, it is estimated that storm damage along Spark Brook and adjacent areas of Walker Brook would not be serious but dam failure would probably cause wash out of the roads near bridges but little further damage, due to about two (2) foot higher river stages. Along lower reaches of Walker Brook, below damage center 4, more damage would be caused by the storm flood at river stages of fourteen (14) to seventeen (17) feet than by the additional flow of dam failures with about four to five feet additional depth. It is estimated that five additional homes or business buildings would be damaged by the addition of dam failure flow. Dam failure effects below the confluence with the Westfield Rver would probably not be significant.

This analysis is summarized in the following table.

DOWNSTREAM IMPACTS OF DAM FAILURE

				Before Dam Failure			After Dam Failure			
Map Location No.	From Dam Feet	Feature	No. of dwellings (Buildings)	Flood Stage cfs-ft.	Depth Over Rd. Ft.	Buildings Damaged	Flood Stage cfs-ft.	Depth Over Road feet	Bldg. Damaged Feet	Comments
0	0	Dam	0	750 7.0		0	7,515 11		0	
1	600	Bonny Rigg Hill Rd.	0	750 7.0	0.7	0	7,310 11	2.0	0	Rd. wash out if dam fails
2	7,000	Rt. 20 over Spark Brk	0	1,464 3.0	0.2	0	7,815 5.9	2.5	0	Rd. wash out if dam fails
3	10,000	Rt. 20 over Walker Brk	0	8,144 13.7	1.3	0	14,350 18.4	4.9	0	Rd. wash out if dam fails
4	13,000	Rt. 20 over Walker Brk	1	8,144 13.7	2.1	0	14,120 18.2	4.2	0	Rd. wash out from storm
5	16,000	Rt. 20 over Walker Brk	1	11,375 16.4	6.7	1	17,150 20.0	8.8	1	Rd. wash out; hse wash out from storm
6	19,000	Blandford Rd. over Walker Brook	2	12,480 17.1	1.5	1	18,060 21.1	5.2	2	Rd & hse. wash out from storm; 2nd hse wash out if dam fails
7	22,000	Walker Island Campground	50 seasonal 1 perm.	13,050 6.9	2.9	50 1	18,420 7.8	3.8	50 1	Rd. & camp wash out from storm
8	25,000	Town Rd. over Walker Brk	4	14,030 9.5	1.7	2	19,300 11.2	5.2	2	Rd. & 2 hses wash out by storm
9	38,000	Rt. 20 over Walker Brk	15	14,030 9.6	2.7	8	18,710 11.0	4.4	12	Rd & Hse wash out by storm; 4 additional houses wash out if dam fails
9	38,500	Town St. over Westfield Rvr	50	35,300 13.5	0	0	40,000 14.2	0	0	Area is safe



- SCALE -

1000' 0' 1000' 2000' 3000' 4000'

FROM USGS OTIS
BECKET
CHESTER

DRAINAGE AREA

DAMAGE CENTER ①

SWAMPS

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

INDIAN LAKE DAM (MA01051) BECKET
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: AS NOTED
DATE: DECEMBER 1979

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

Visual inspection revealed no signs of significant displacement of the embankment or structures. The southeast spillway wall shows signs of a cold joint during concrete placement. Seepage and efflorescence along this line indicates that active deterioration is underway which might result in a hazardous condition in the future.

6.2 Design and Construction Data

A review of the construction plans indicates that the structures were designed in accordance with standard engineering practice. A review of the construction notes indicates that the embankment was constructed in accordance with standard engineering practice as far as it progressed.

6.3 Post Construction Changes

The Massachusetts Division of Waterways inspection report for October 20, 1977 indicates that flashboards were in place to elev. 1478 which is about 1 foot above the maximum design pond elevation. Some flashboards were subsequently removed. At the time of this inspection, flashboards were about 1.4 feet above the concrete spillway crest (elev. 1474.4 MSL).

The October, 1977 inspection reported a wet area about 8 feet from the top of the dam left of the spillway and seepage of about 1 gpm at a point about 2 feet up from toe about 25 feet left of the spillway. This was not noted at this inspection.

6.4 Seismic Stability

The dam is located in seismic zone No. 2. According to the recommended Corps of Engineers Guidelines, a seismic analysis is not warranted.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

(a) Condition

The dam is generally in fair condition. The embankment and spillway are stable. The embankment has not b completed to design height, the downstream slopes are not pro.ected and the left foundation drain is not operating properly. There are signs of leakage through and under the left embankment. The spillway bridge for access to the stop log facilities and the fence at the spillway wing walls have not been installed. The cold concrete joint could eventually be a hazard.

(b) Adequacy of Information

There is sufficient design and construction data to permit an assessment of dam safety when combined with visual inspection, past performance, and sound engineering judgment.

(c) Urgency

The recommendations and remedial measures described herein should be implemented within one year of receipt of this Phase I Inspection Report.

7.2 Recommendations

The recommendations of this Phase 1 investigation are that the following additional studies or modifications be made under the supervision of a registered professional engineer:

1. Complete embankment to full design height

2. Provide downstream slope protection, preferably with riprap stone, that will discourage motorcycle trespass and reduce the rate of erosion .

3. Modify the stop log guides so that thick flashboards cannot be installed and the guide height is limited to a safe elevation.

4. Replace existing stop log with flashboards of appropriate thickness to allow washout during floods.

5. Install spillway bridge to facilitate flashboard operation.

6. Grout or seal the concrete cold joint to prevent further deterioration of concrete and reinforcing steel.

7. Excavate at a number of locations along the left foundation toe drain to determine the cause of the malfunction of this drain; implement appropriate corrective measures once the source of the malfunction is determined.

7.3 Remedial Measures

The following remedial operation and maintenance procedures are recommended:

1. Immediately remove all stop logs or flashboards from spillway and keep them removed and away from the dam site until all recommendations and remedial measures have been completed.

2. Develop a downstream emergency flood response and warning system.

3. Develop a program of annual technical inspections.

4. Develop a program of regular monthly operation and maintenance inspections.

5. Establish a monitoring procedure and program at the dam during and just after periods of intense rainfall or flooding.

6. Repair sluice gate lift stand and mount.

7.4 Alternatives

There are no meaningful alternatives to the above recommendations except as follows:

1. Recommendation 7.2-3 - In lieu of modifying the stop log guides, they should be removed or blocked to prevent installation of any stop logs.

2. The dam may be drained by removing the sluice gate and breaching the embankment to a width of at least 25 feet and a height near the bottom of the reservoir.

APPENDIX A

INSPECTION CHECKLIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Indian Lake Dam

DATE 10/31/79

TIME 7:00-10:30 A.M.

WEATHER Clear, calm, fair-50°F

W.S. ELEV. 1474.4 U.S. 1466± DN.S.
Based on design elevation of structures

PARTY:

1.	J.W. Powers, P.E. Project Manager	6.	
2.	G.H. McDonnell, P.E., Hydrology/ Hydraulics	7.	
3.	E.A. Moe, P.E., Soils/Hydraulics	8.	
4.	H.A. Koski, Civil	9.	
5.	O.H. Dumais, Civil	10.	

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	All project features were inspected by all party members.		
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

INSPECTION CHECK LIST

PROJECT Indian Lake Dam — DATE 10/31/79

PROJECT FEATURE Embankment — NAME Tighe & Bond party

DISCIPLINE ______ — NAME ______

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	SE end: 1.1' lower than conc. wall, to 117' out. NW end: 1.05' lower than conc. wall to 52' out, where it is 0.3'± low, to grade 168' out
Current Pool Elevation	1.45' above concrete crest
Maximum Impoundment to Date	Water mark 1.1' below top of conc. wing wall. Tail water maximum 11.6' below top of concrete wing wall
Surface Cracks	No surface cracks evident
Pavement Condition	No pavement
Movement or Settlement of Crest	Center is 1.1' low both sides of spillway. Probably constructed low not settlement.
Lateral Movement	None evident
Vertical Alignment	1.1' low at spillway - see above
Horizontal Alignment	Approximately as plans show
Condition at Abutment and at Concrete Structures	1.1' low see above
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Motorcycle tracks on downstream & top.
Vegitation on Slopes	None except on loam piles that have not been spread
Sloughing or Erosion of Slopes or Abutments	Minor rain rills in downstream gravely slope
Rock Slope Protection - Riprap Failures	None evident
Unusual Movement or Cracking at or near Toes	None evident
Unusual Embankment or Downstream Seepage	None
Piping or Boils	None
Foundation Drainage Features	[illegible] toe drain had been plugged. Flowed freely-no sand or grit. ½"x6"x1 fps .020 cfs. Pipe offset at joint: ¼" low in bank.
Toe Drains	N.E. toe drain dry. Offset at joint 3/4" low in embankment should be checked.
Instrumentation System	None

INSPECTION CHECK LIST

PROJECT Indian Lake Dam

DATE 10/31/79

PROJECT FEATURE

NAME Tighe & Bond party

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Submerged
Slope Conditions	Good
Bottom Conditions	Submerged, not visible due to turbidity
Rock Slides or Falls	None
Log Boom	None
Debris	None
Condition of Concrete Lining	Good, except south wing wall shows cold pour joint in concrete. Reinforcing steel & tie wire protruded from top of wing wall back-up
Drains or Weep Holes	None visible
b. Intake Structure	Gate & thimble submerged and not visible
Condition of Concrete	Good
Stop Logs and Slots	Good, top 1.45' above concrete crest. 3/4" water over top of stop logs.

INSPECTION CHECK LIST

PROJECT Indian Lake Dam

DATE 10/31/79

PROJECT FEATURE

NAME Tighe & Bond party

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	West wall good. East wall shows cold joint in concrete pour near mid height.
Condition of Joints	Satisfactory, only minor shifting evident
Spalling	None
Visible Reinforcing	None
Rusting or Staining of Concrete	Rusty re. steel & tie wire protrudes above south wing wall back up block.
Any Seepage or Efflorescence	On SE wall. Seepage & efflorescence is higher near embankment center than at downstream toe. 1' above tail water at
Joint Alignment	toe. 3'-4' near center of stilling basin
Unusual Seepage or Leaks in Gate Chamber	None visible. Gate was submerged.
Cracks	Minor cold joint cracks in SE wall
Rusting or Corrosion of Steel	No fence or cat walk. Fence post sockets are rusting
b. Mechanical and Electrical	
Air Vents	None
Float Wells	None
Crane Hoist	None
Elevator	None
Hydraulic System	None
Service Gates	Rodney Hunt 43941-2/S-5002-A one base bolt on stand missing
Emergency Gates	Stop logs
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System in Gate Chamber	None

INSPECTION CHECK LIST

PROJECT Indian Lake Dam	DATE 10/31/79
PROJECT FEATURE	NAME Tighe & Bond party
DISCIPLINE	NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	NONE
General Condition of Concrete	See other pages
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

INSPECTION CHECK LIST

PROJECT Indian Lake

DATE 10/31/79

PROJECT FEATURE

NAME Tighe & Bond party

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	
Rust or Staining	Good
Spalling	None
Erosion or Cavitation	None
Visible Reinforcing	None
Any Seepage or Efflorescence	None
Condition at Joints	Satisfactory joint open $\leq$ 1/8"
Drain holes	None
Channel	Riprap
Loose Rock or Trees Overhanging Channel	None
Condition of Discharge Channel	Good

INSPECTION CHECK LIST

PROJECT Indian Lake Dam

DATE 10/31/79

PROJECT FEATURE

NAME Tighe & Bond party

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Submerged
General Condition	Features above water are in good condition
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Submerged
b. Weir and Training Walls	
General Condition of Concrete	Good except seepage and efflorescence
Rust or Staining	None
Spalling	
Any Visible Reinforcing	None
Any Seepage or Efflorescence	SW wing wall & channel wall has seepage & efflorescence 1' above tail water near end & 3'-4' above tail water at dam ℄
Drain Holes	None
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	
Floor of Channel	Riprap Transition to curve
Other Obstructions	

INSPECTION CHECK LIST

PROJECT Indian Lake Dam

DATE 10/31/79

PROJECT FEATURE

NAME Tighe & Bond/SCI

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE</u>	
a. Super Structure	None in place
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	None. Pipe sockets rusting rapidly
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

APPENDIX B

ENGINEERING DATA

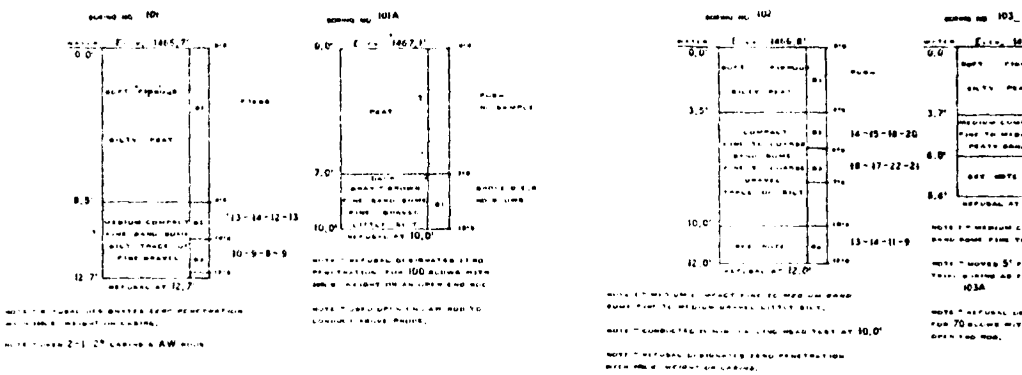
Design and construction information is located at the following places.

Item	Location
Design data	Barnes & Jarvis, Inc., 61 Batterymarch St., Boston, Mass.
Earthwork design	Haley & Aldrich, Inc., 238 Main St. Cambridge, Mass.
Construction records	Haley & Aldrich, Inc.
As-built plans	Mr. John Hannon, Mass. DEQE, Waterways Division, 100 Nashua St., Boston, Mass. 02114
Inspection Reports	Mr. John Hannon, Mass. DEQE, Waterways Division

Copies of sheets 2, 3, 4, and 5 of as-built plans are attached hereafter.

A copy of the Massachusetts Division of Waterways inspection report is attached hereafter.

BORI



TE

TEST PIT REPORT — TEST PIT NO. TP-1

PROJECT: PROPOSED DAM SITE, BECKET, MASS.
CLIENT: BARNES & JARRIS, INC., BOSTON, MASS.
CONTRACTOR: ANDREWS CONSTRUCTION CO., BECKET, MASS.
EQUIPMENT USED: J.D. #3500 Backhoe, 3/8 cu. yd.

- 0.0 — Dark brown-black loamy FOREST MAT, trace roots (TOPSOIL)
- 1.5 — Red brown fine sandy SILT, trace gravel, cobbles (LOESS)
- 2.0 — fine SAND, little gravel
- 3.3 — Red brown coarse to fine SAND, little gravel, trace silt
- 3.8 — Yellow fine SAND, little silt, trace gravel
- 5.5 — Brown medium to fine SAND, trace coarse sand, trace gravel
- 6.0 — Yellow brown gravelly coarse to fine SAND, trace cobbles and silt
- 7.8 — Yellow brown, gray brown, well bonded, fine SAND to coarse to fine SAND, trace silt, trace gravel, trace cobbles (TILL LIKE)
- 9.0 — Gray well bonded medium to fine SAND, little silt, trace cobbles (GLACIAL TILL)
- 10.0 — Gray gravelly coarse to fine SAND, trace to little silt

Bottom of exploration

Water seepage at 9.0'

TEST PIT REPORT — TEST PIT NO. TP-2

PROJECT: PROPOSED DAM SITE, BECKET, MASS.
CLIENT: BARNES & JARRIS, INC., BOSTON, MASS.
CONTRACTOR: ANDREWS CONSTRUCTION CO., BECKET, MASS.
EQUIPMENT USED: J.D. #3500 Backhoe, 3/8 cu. yd.

- Yellow brown medium to fine SAND, little gravel, trace silt
- Yellow brown ... fine sandy SILT, ... large boulders
- Yellow brown medium to fine SAND
- Brown coarse to fine sandy GRAVEL, trace silt
- Brown coarse to fine SAND, trace gravel
- Yellow brown ... fine sandy SILT, ... cobbles and boulders
- Brown gravelly coarse to fine SAND ... cobbles and boulders - PROBABLE GLACIAL TILL -

Refusal on Boulders

TEST PIT REPORT — TEST PIT NO. TP-3

PROJECT: PROPOSED DAM SITE, BECKET, MASS.
CLIENT: BARNES & JARRIS, INC., BOSTON, MASS.
CONTRACTOR: ANDREWS CONSTRUCTION CO., BECKET, MASS.
EQUIPMENT USED: J.D. #3500 Backhoe, 3/8 cu. yd.

- Yellow brown medium to fine SAND, trace silt and gravel, trace cobbles
- ... coarse to fine sandy GRAVEL ... cobbles and boulders
- Gray gravelly coarse to fine SAND, trace silt, cobbles and small boulders - GLACIAL TILL -

Bottom of exploration

Extremely difficult to ... cobbles and boulders ...

TEST PIT REPORT — TEST PIT NO. TP-4

PROJECT: PROPOSED DAM SITE, BECKET, MASS.
CLIENT: BARNES & JARRIS, INC., BOSTON, MASS.
CONTRACTOR: ANDREWS CONSTRUCTION CO., BECKET, MASS.
EQUIPMENT USED: J.D. #3500 Backhoe, 3/8 cu. yd.

- Black FOREST MAT & ROOTS, ...
- ... SILT, ... (LOESS)
- Yellow brown silty fine SAND, trace gravel, roots (LOESS)
- Brownish gray silty SAND, little gravel, cobbles and boulders ... (GLACIAL TILL)

Bottom of exploration

Till is extremely difficult to excavate

Boulder Count

TEST PIT REPORT — TEST PIT NO. TP-5

PROJECT: PROPOSED DAM SITE, BECKET, MASS.
CLIENT: BARNES & JARRIS, INC., BOSTON, MASS.
CONTRACTOR: ANDREWS CONSTRUCTION CO., BECKET, MASS.
EQUIPMENT USED: J.D. #3500 Backhoe, 3/8 cu. yd.

- Light brown ... medium to fine SAND, trace gravel
- ... medium to fine SAND, little silt, trace gravel
- Light ... brown fine sandy SILT
- Light brown ... coarse SAND ...
- Light brown fine SAND, little silt
- ... gravelly coarse to fine SAND, little silt
- Bottom of test pit - Unable to dig deeper due to large boulders

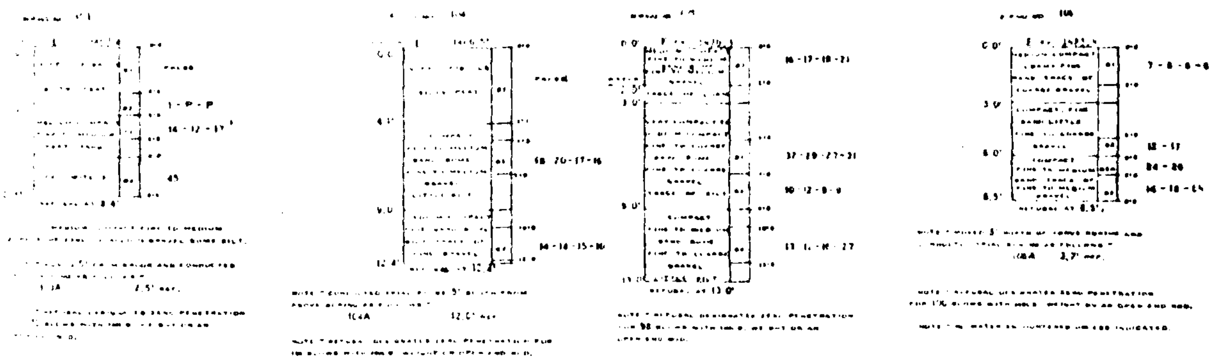
TEST PIT REPORT — TEST PIT NO. TP-6

PROJECT: PROPOSED DAM SITE, BECKET, MASS.
CLIENT: BARNES & JARRIS, INC., BOSTON, MASS.
CONTRACTOR: ANDREWS CONSTRUCTION CO., BECKET, MASS.
EQUIPMENT USED: J.D. #3500 Backhoe, 3/4 cu. yd.

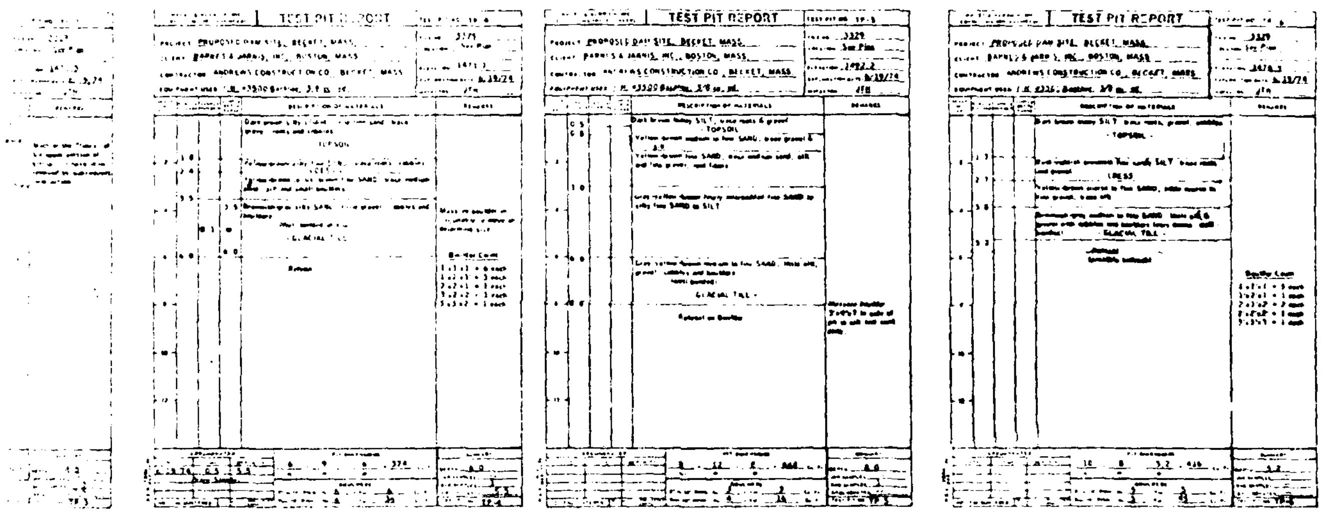
- Light gray and brown ... to fine SAND, with gravel, cobbles, ... boulders ... - GLACIAL TILL -

Refusal on Boulders

BORING LOGS



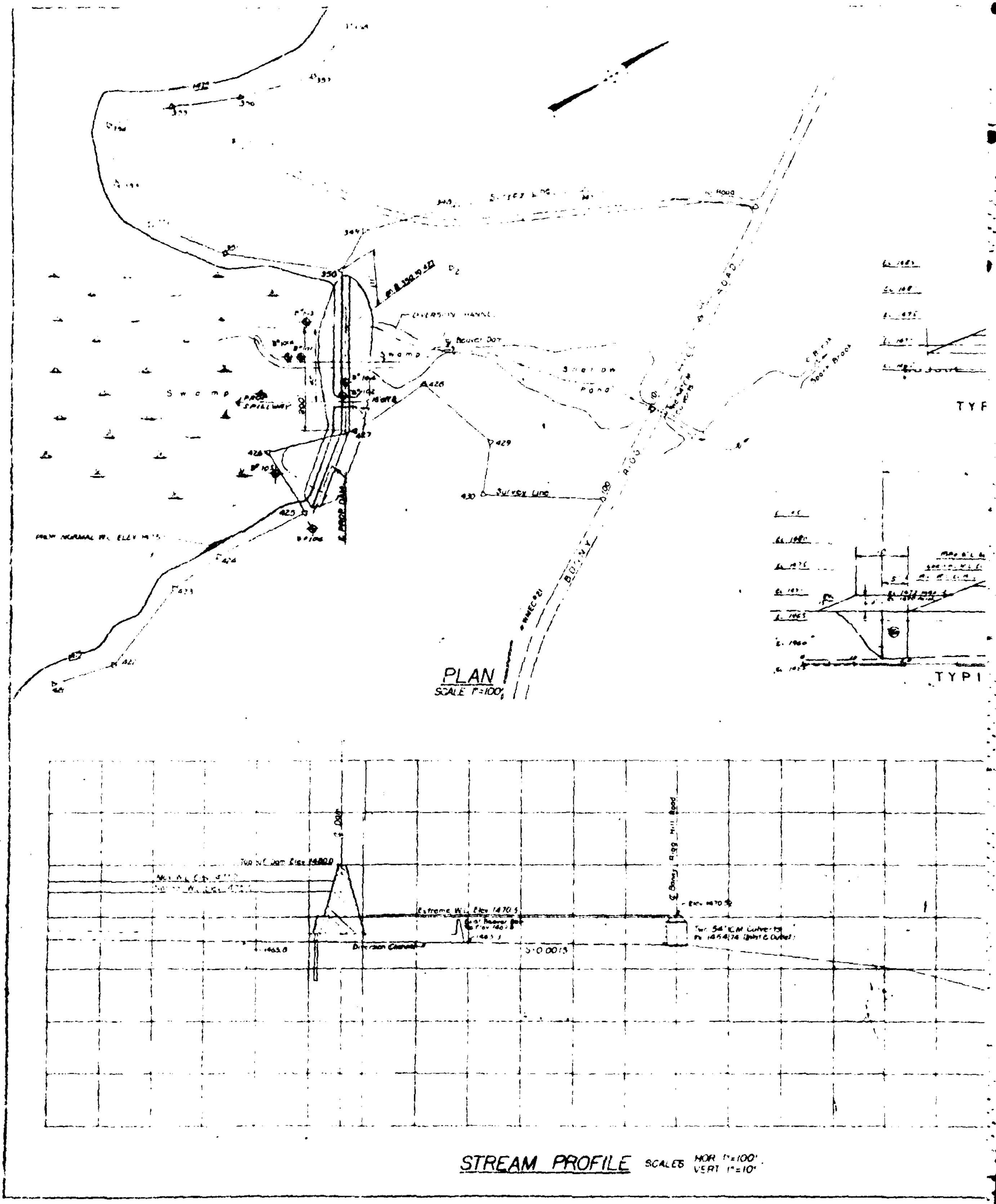
TEST PITS



BORING AND TEST PIT NOTES

1. Location of Borings and Test Pits are shown on Sheet No. 4.
2. Borings were taken on June 19, [illegible], 1974 by [illegible] Drilling and Boring Co., Inc., Braintree, Mass.
3. Water reading on boring logs [illegible] of borings [illegible] otherwise noted.
4. Figures [illegible] Boring [illegible] split [illegible] specified, [illegible]
5. "ST" in boring log [illegible]

INDIAN LAKE DEVELOPMENT, BECKET, MASS.	JOB NO. 73-260
BORINGS LOGS	SCALE
BARNES & JARNIS, Engineers	DATE 8/6/74
[illegible] STREET, BOSTON, MASS.	DR. BY CAD / CK. BY [illegible]
[illegible] & ASSOCIATES, INC., Land Surveyors, South Deerfield, Mass.	SHEET NO. 2
[illegible], INC., Consulting Soil Engineers, Cambridge, Mass.	


Swamp
PROP SPILLWAY
Survey Line
Sharon Pond
BONEY RIGG ROAD
PLAN
SCALE 1"=100'
TYP
TYPI
Top of Dam Elev 1480.0
Extreme W.L. Elev 1470.5
Diversion Channel
STREAM PROFILE
SCALES HOR 1"=100' VERT 1"=10'

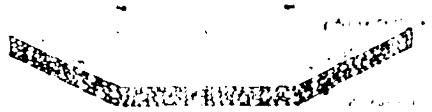
[illegible] TEMPORARY STREAM DIVERSION

Diversion channel to be lined with cobbles and boulders of [illegible] size to max. size which can be incorporated within channel lining layer.

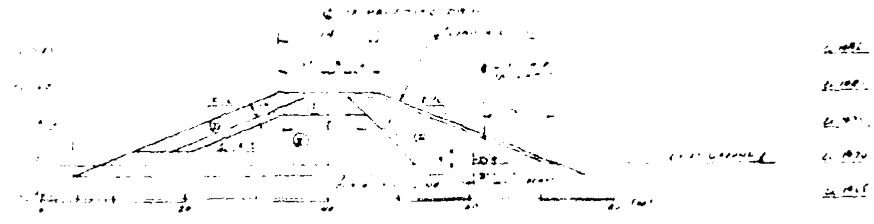
2. After completion of constructing the Stilling Basin, the Spillway structure and installing the Drain, redivert stream into principal spillway.

3. [illegible] channel lining and all [illegible] material from channel excavation within the [illegible] area and flatten channel side slopes to [illegible]

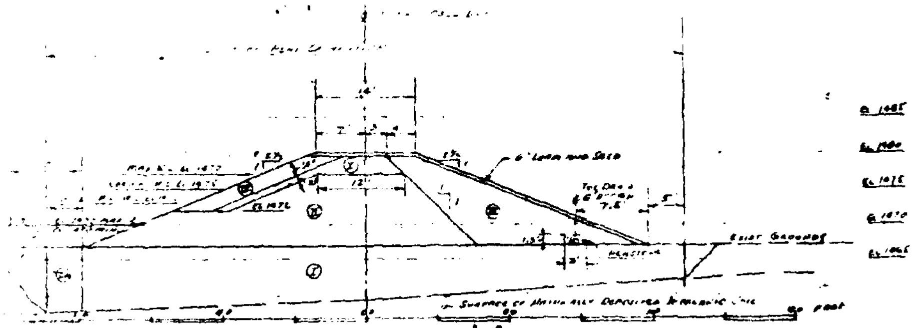
4. Backfill [illegible] excavation with embankment material following completion of [illegible]



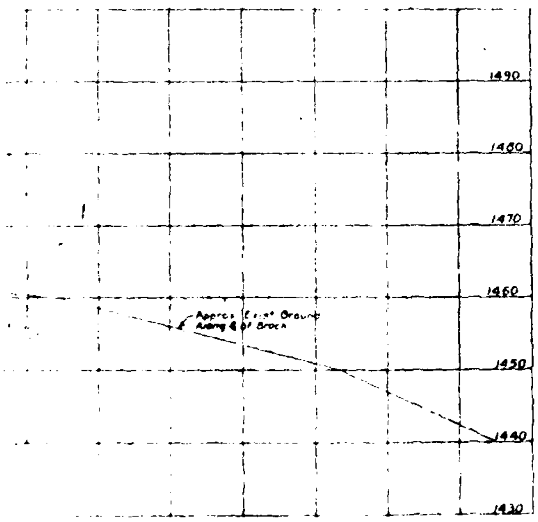
TYPICAL SECTION
DIVERSION CHANNEL



TYPICAL DAM SECTION "A"



TYPICAL DAM SECTION "B"
SCALE: 1" = 10'

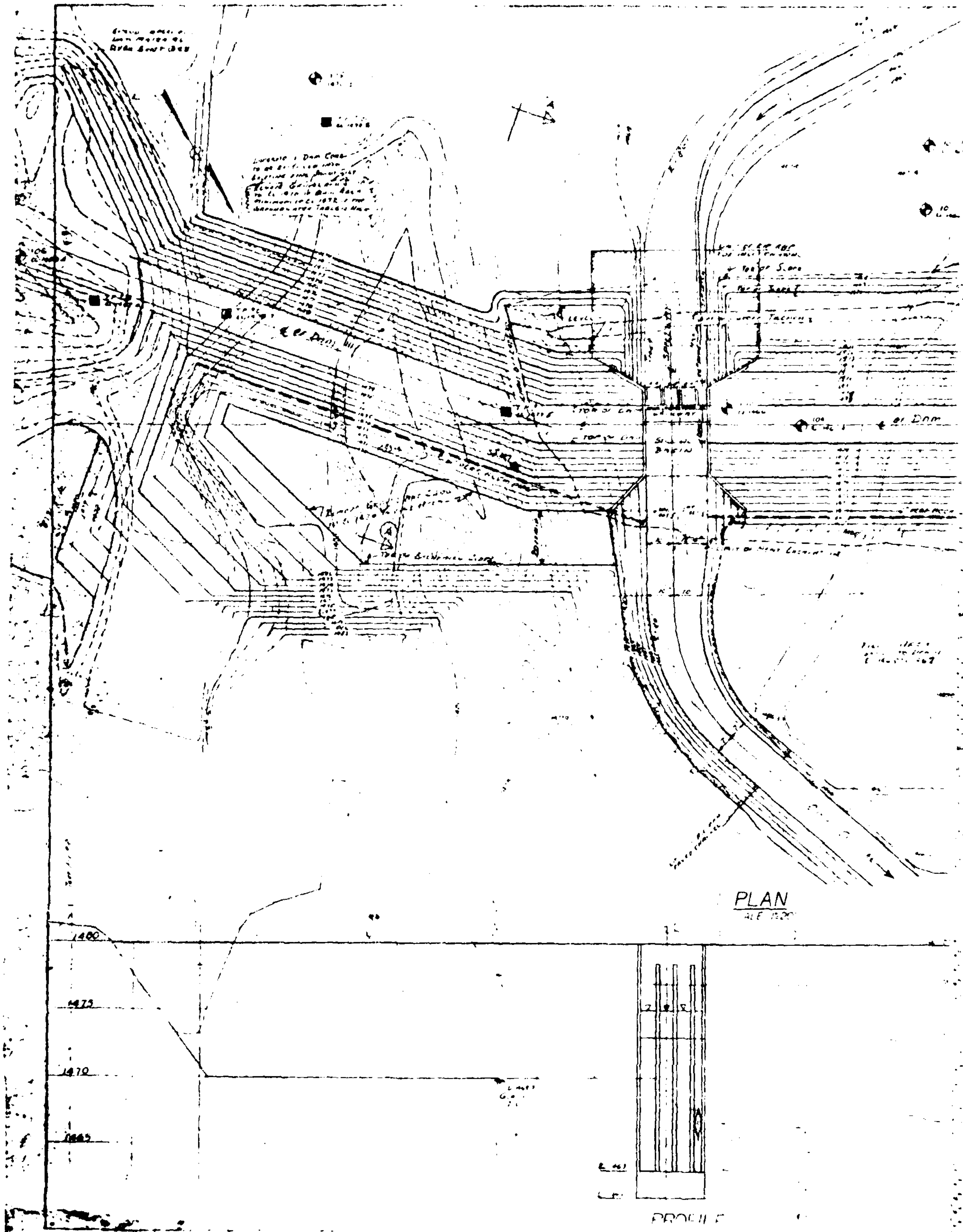


TYPICAL CROSS SECTIONS FOR DAM

MATERIAL	DESCRIPTION	
I	Gravel Borrow	On site clean sandy gravel or [illegible] sand to be used to construct the dam foundation where peat will be [illegible] below groundwater level and fill must be placed "in-the-wet".
II	Impervious Borrow	Glacial till containing a [illegible] silt and clay obtained [illegible] sources. Placed and compacted in layers to form a seepage cut-off.
IIa	Impervious Borrow	Identical to II. Placed [illegible] Compacted at surface.
III	Granular Borrow	[illegible] sand, gravel, [illegible] gravelly sand. Placed [illegible] in layers.
IV	Rip Rap	Dumped rock fill having a [illegible] [illegible] by weight greater than 12" [illegible] size [illegible]

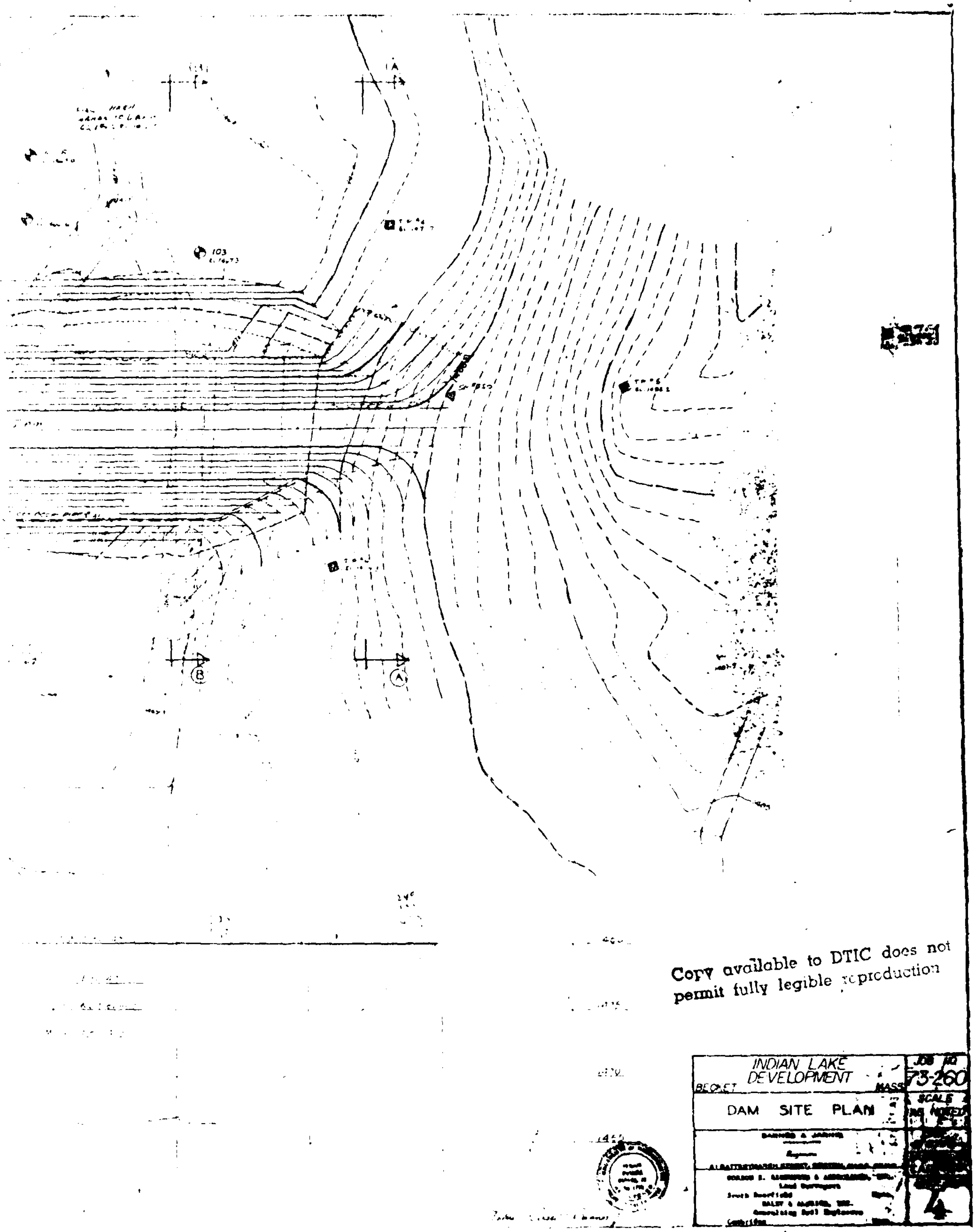
Copy available to DTIC does not permit fully legible reproduction

INDIAN LAKE DEVELOPMENT	JOB NO. 73-260
OUTLET STREAM DAM SECTIONS & PLAN	SCALE AS NOTED
[illegible] Engineers	DATE [illegible]
[illegible] Land Surveyors	DR. CHECK BY CAB [illegible]
[illegible] Consulting Soil Engineers, Cambridge	SHEET NO. 3



Sheet 11

1 of 2



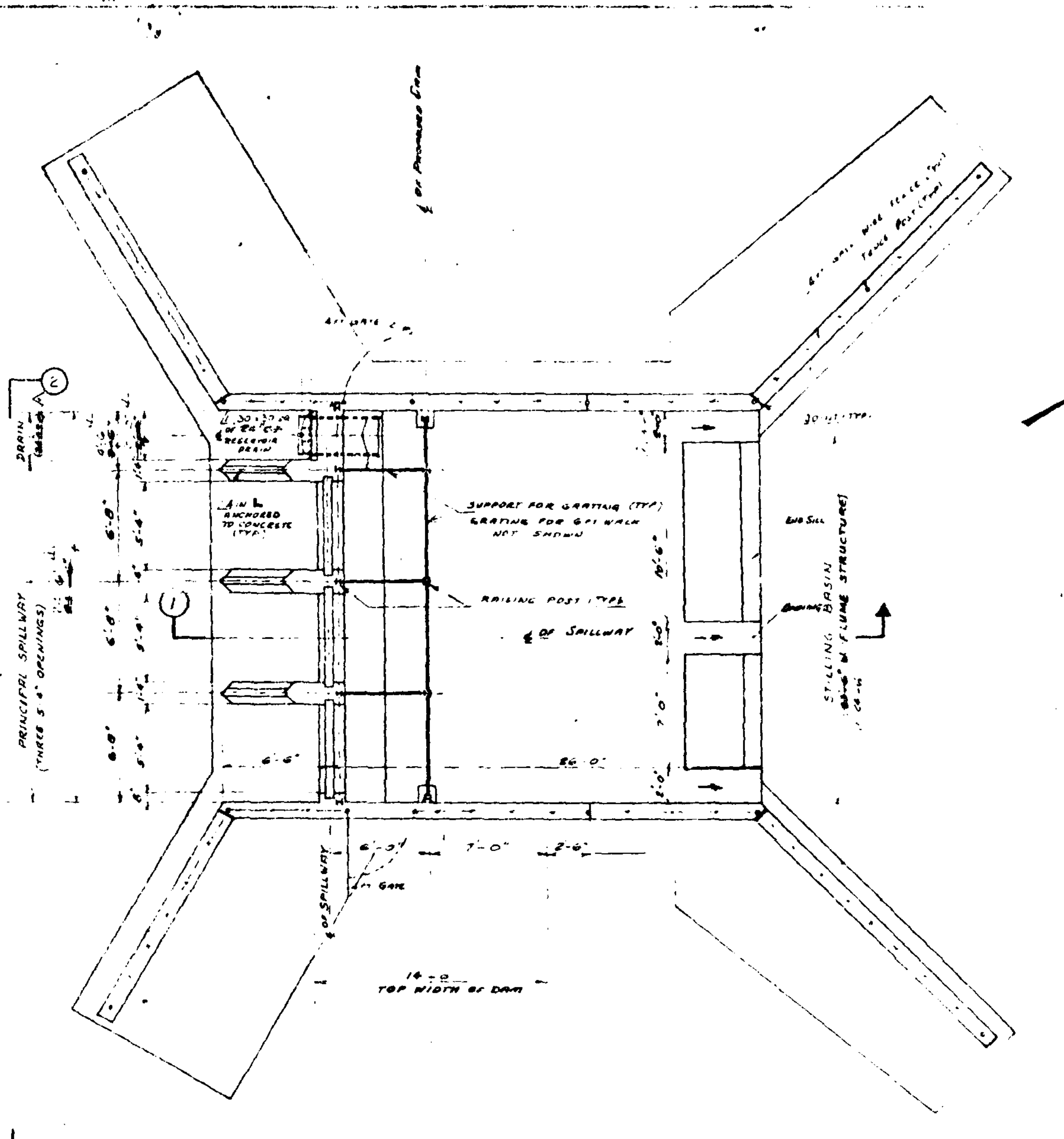
INDIAN LAKE DEVELOPMENT

BECKET MASS.

JOB NO. 73-260

DAM SITE PLAN

SCALE AS NOTED



PLAN

[illegible]

[illegible]

[illegible] ... be provided.

[illegible] shall be Cast Iron with bronze bushings.

[illegible] for supporting floor stand shall be [illegible] holes for anchor bolts for [illegible] concrete.

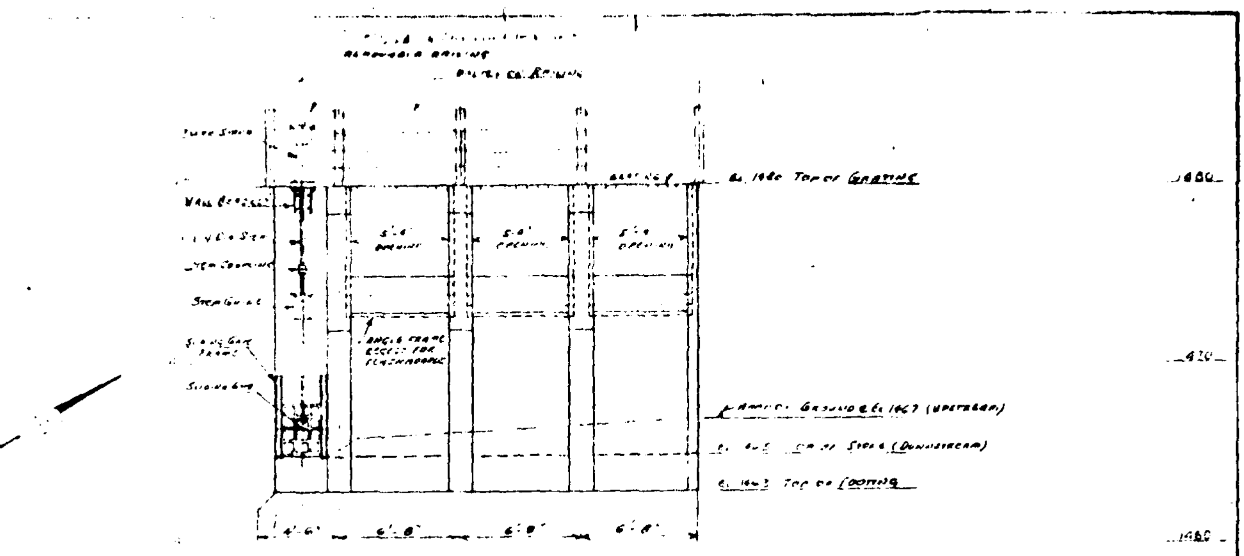
[illegible] shall be [illegible] with bronze seat, facing [illegible] and shall be template drilled for attachment to wall thimble.

[illegible]

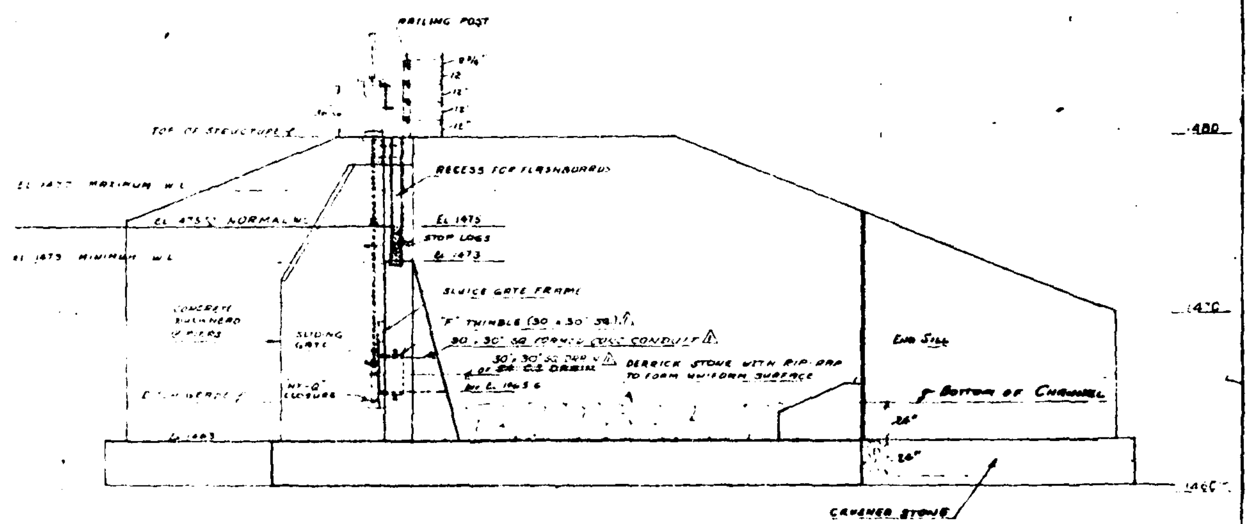
[illegible]

NOTE: [illegible] FOR ALL STRUCTURAL [illegible]

THE APPLICATION OF GALVANIZING TO [illegible] METAL AS CALLED FOR ON DRAWING WILL BE AT THE DISCRETION OF THE OWNER.



SECTION 2 - 2



SECTION 1 - 1

ISSUED FOR CONSTRUCTION

REVISIONS

DESCRIPTION

INDIAN LAKE DEVELOPMENT

BECKET MASS.

JOB NO. 73-260

SPILLWAY STRUCTURE

L-168

U-19
Preliminary File

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: ~~City~~/Town BECKET Dam No. 1-2-22-17

   Name of Dam Indian Lake Inspected by RDJordan-RSpaniol

   Date of Inspection October 20, 1977

   Previous Inspection ________

2. Owner/s per: Assessors ________
   Reg.of Deeds ________ Personal Contact ________

   1. J. F. Hansman — Indian Lake Estates — Becket, MA
      Name — St. & No. — City/Town/State — Tel. No.

   2. ________
      Name — St. & No. — City/Town/State — Tel No.

3. Caretaker (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

   ____
   Name — St.& No. — City/Town/State — Tel.No.

4. No. of Pictures taken ________

5. Degree of Hazard: (If dam should fail completely)*

   1. Minor X 2. Moderate ________

   3. Severe ________ 4. Disastrous ________

   *This rating may change as land use changes (future development)

6. Outlet Control: Automatic ________ Manual X

   Operative X Yes ________ No ________

   Comments: ________

7. Upstream Face of Dam:

   Condition: 1. Good X 2. Minor Repairs ________

   3. Major Repairs ________ 4. Urgent Repairs ________

   Comments: ________

L-168-A

DAM NO. 1-2-22-17

8. Downstream Face of Dam:

Condition: 1. Good ______ 2. Minor Repairs X

3. Major Repairs ______ 4. Urgent Repairs ______

9. Emergency Spillway

Condition: 1. Good ______ 2. Minor Repairs ______

3. Major Repairs ______ 4. Urgent Repairs ______

Comments: ______

10. Water level at time of inspection 0.4 above X below ______

top of dam ______

principal spillway ______

other Splashboards

11. Summary of Deficiencies Noted:

- ______ Growth (Trees & Brush) on Embankment ______
- ______ Animal Burrows and Washouts ______
- ______ Damage to slopes or top of dam ______
- ______ Cracked or damaged masonry ______
- X Evidence of seepage ______
- ______ Evidence of piping ______
- X Erosion ______
- X Leaks ______
- ______ Trash and/or debris impeding flow ______
- ______ Clogged or blocked spillway ______
- ______ Other ______

12. Remarks & Recommendations; (Fully Explain).
PREVIOUS INSPECTION DATE: NEW STRUCTURE

This new structure has not been completed. The downstream slope and top of embankment have not been seeded and due to the lack of turf cover, small areas of minor erosion have developed.

The chain link fence and spillway catwalk have not been installed. Without the catwalk, the installation and removal of the flashboards is difficult and hazardous. This work was to have been completed in early 1976.

On this date, the pond elevation was extremely high. The flashboards in place exceed the maximum design pond elevation by approximately one foot, and five inches of water was flowing over the boards. Settlement has occurred at both sides of the spillway and the dam is within one foot of topping.

On the left side of the spillway, approximately eight feet from the top of the dam we found a very soft wet area approximately three feet in diameter. Although no flow was observed, this condition should be investigated.

Approximately 25' from the left abutment, two feet up from the toe, a flow of approximately 1 GPM was found. It appears to be coming from the embankment, however, it could be a spring caused by the high water table. This condition also warrents investigation.

Foreclosure proceedings are in progress, and the owner is unavailable. The Community Savings Bank of Springfield is handling the foreclosure, and will soon be the owners of the dam and surrounding property. I spoke with Mr. Guyette, a vice-president of the bank, and expressed my concern with the safety of the structure and advised him to lower the pond by several feet as soon as possible.

With his permission, I contacted the Becket Board of Selectmen and requested them to open the gate and remove the stop logs. To date 8" of boards have been removed, and a total of three feet of boards will be removed over a period of time to safely lower the pond.

For location see Topo Sheet 5-D and 6-B.

13. Overall Condition:

_______ 1. Safe _______________

_______ 2. Minor repairs needed _______________

_______ 3. Conditionally safe - major repairs needed _______________

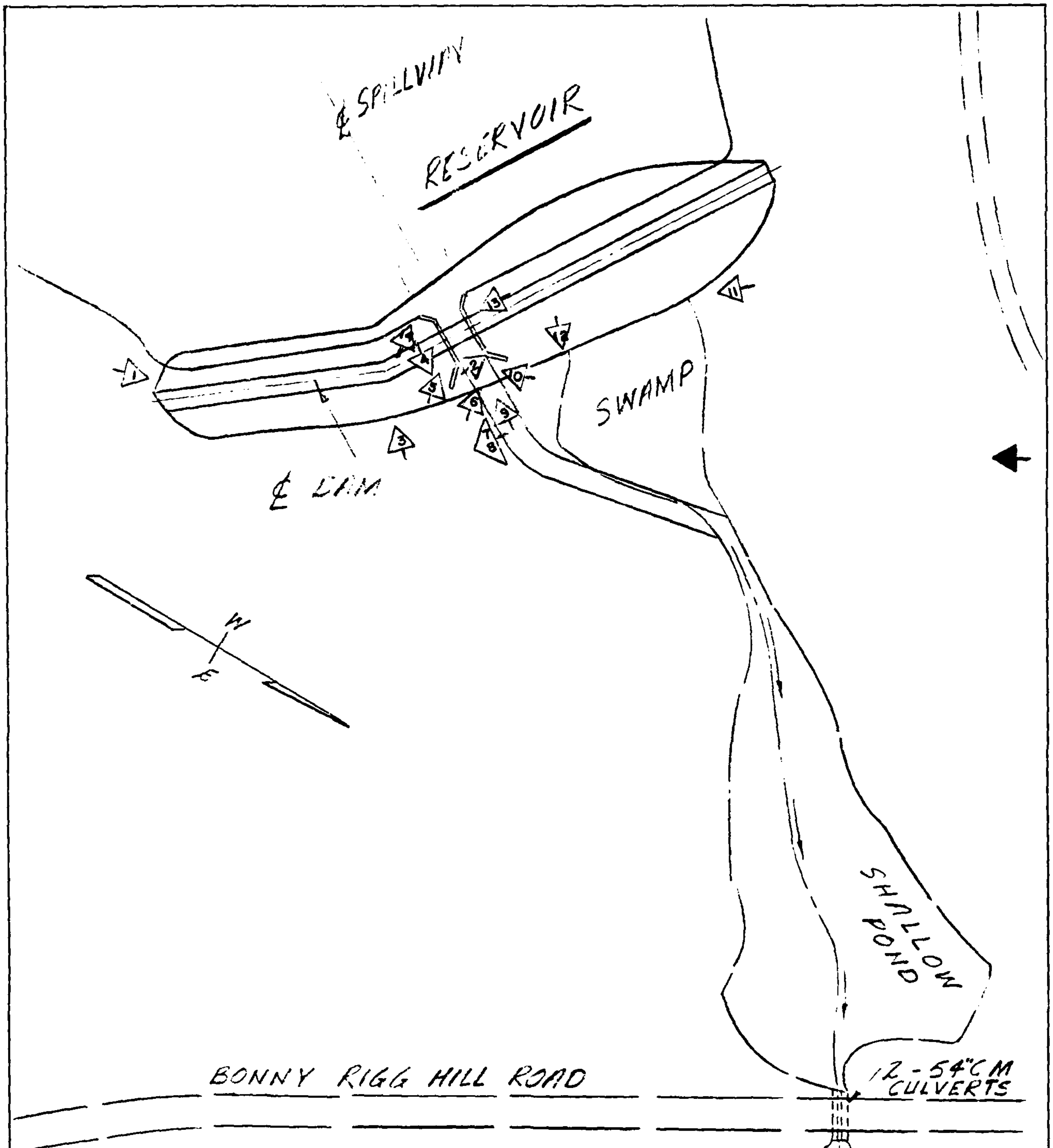
_______ 4. Unsafe _______________

_______ 5. Reservoir impoundment no longer esists (explain)

Recommend removal from inspection list _______________

APPENDIX C

PHOTOGRAPHS



AERIAL OVERVIEW

APPENDIX C

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND ORIENTATION OF PHOTOS

INDIAN LAKE DAM (MA01051) BECKET
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: 1" = 100'

DATE: DECEMBER 1979

PHOTO 1

Looking northwesterly at face of dam

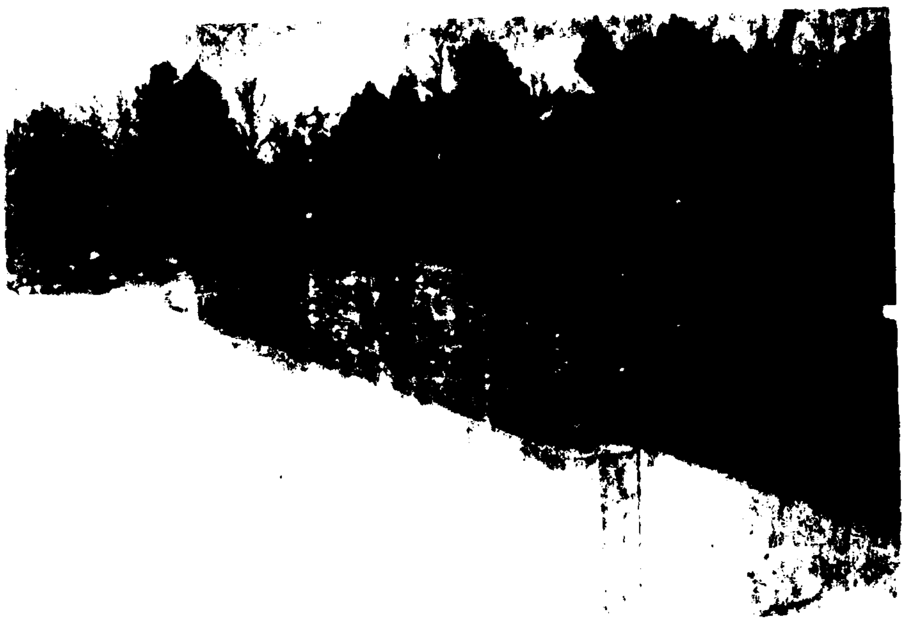
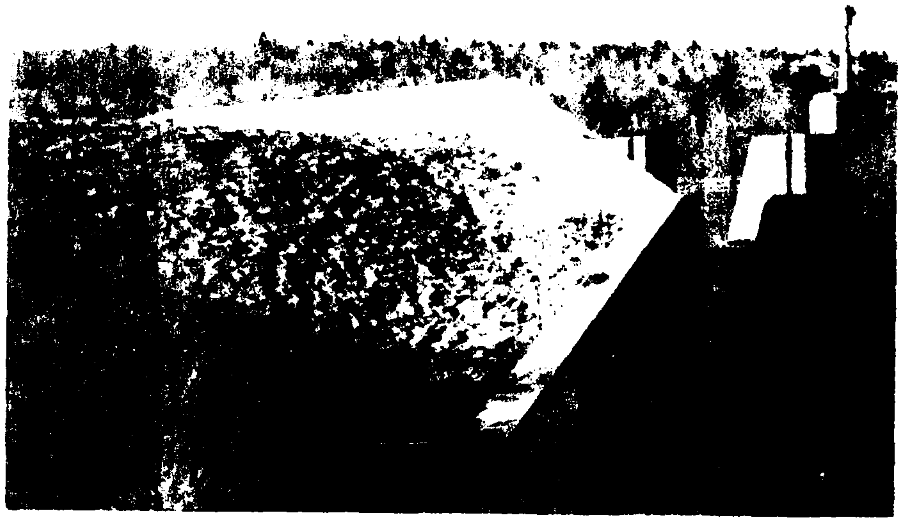


PHOTO 2

Looking west downstream slope west end of dam

PHOTO 3

Looking southwesterly at downstream face southeast end of dam



[illegible] westerly north
[illegible] of spillway wing
[illegible], left founda-
[illegible]on drain

PHOTO 7

Right foundation drain just after clearing sand plug

PHOTO 8

Right foundation drain about 30 minutes after clearing sand plug

PHOTO 9

Looking southwesterly at spillway plunge pool

PHOTO 10

Looking southerly at south- [illegible] spillway wall showing [illegible] joint, leakage and efflorescence

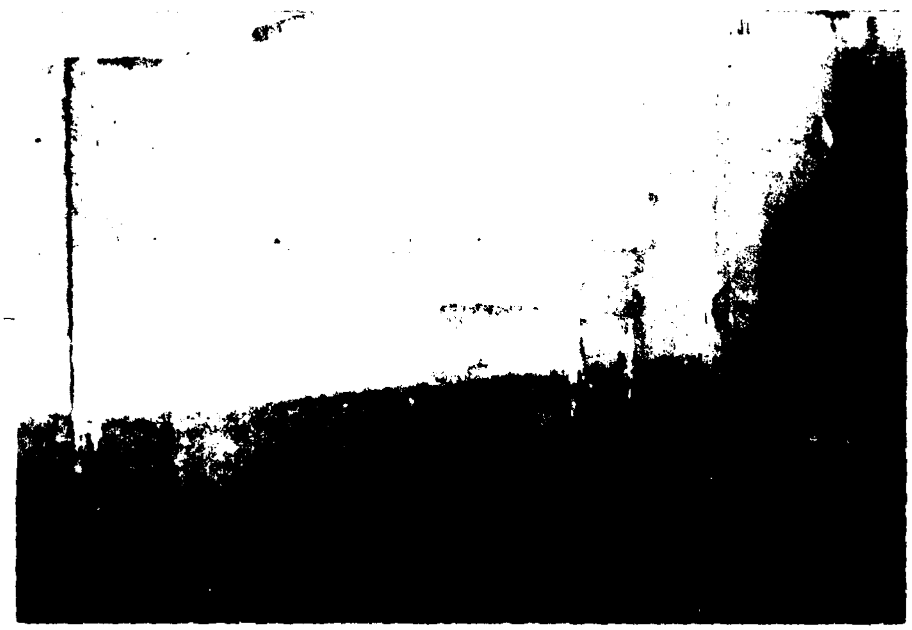
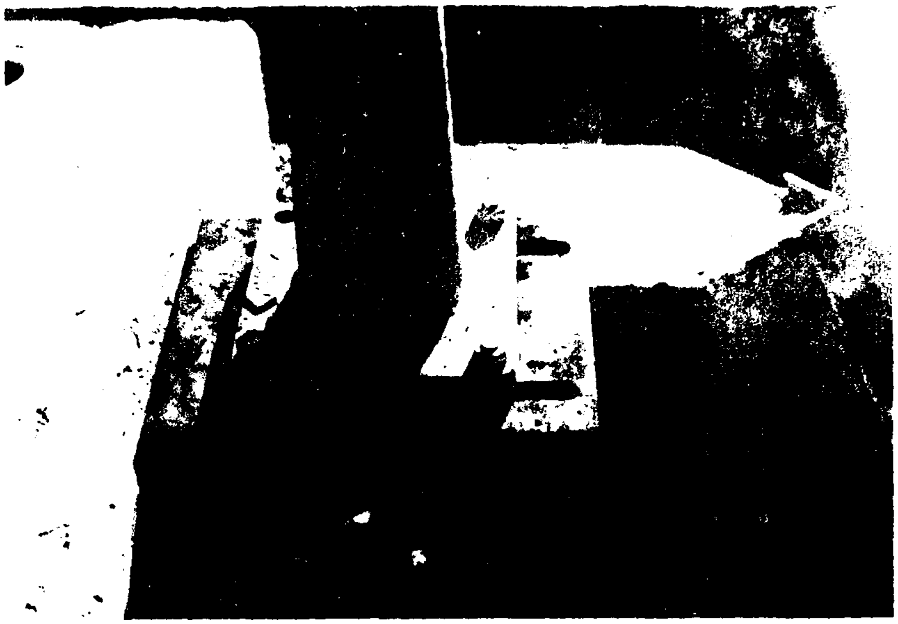


PHOTO 11

Looking southeasterly at water and wet area at left toe of dam

PHOTO 12

Looking north toward Bonny Rigg Hill Road across swamp and outlet brook



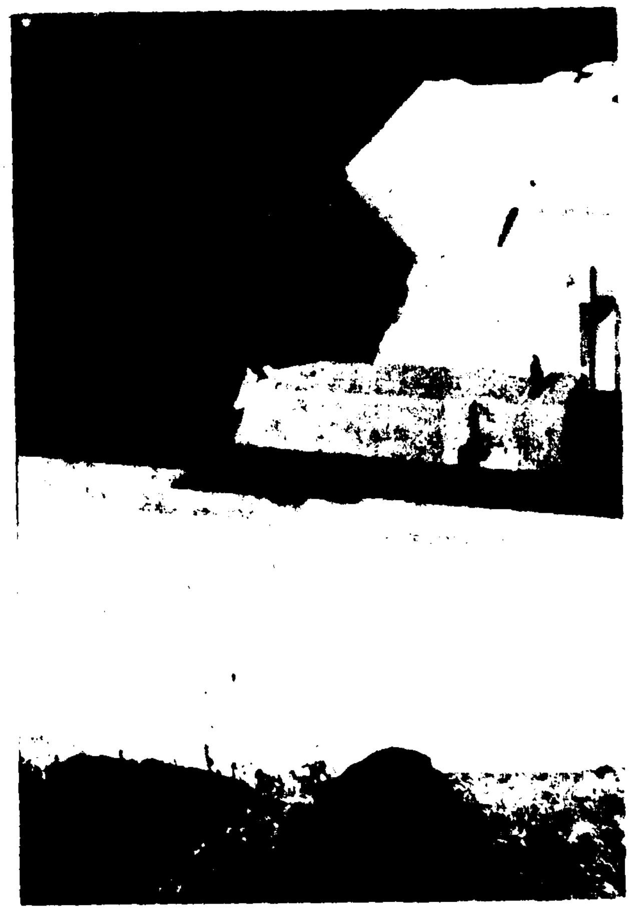


PHOTO 14

Looking west at piers and west spillway inlet wing wall

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

HYDRAULIC COMPUTATIONS

LOCATION

DRAINAGE AREA

DAM SIZE

DISCHARGE CAPACITY

RESERVOIR CAPACITY

D-19-24
11/5/79
MOE.
Chk'd DMc

Indian Lake Dam

Location: N 42° 14' 57"
W 73° 01' 27"

Elevation: normal pool = 1475.0 MSL
From project plans
confirmed by U.S.G.S. - topo sheet
U.S.G.S. Topo sheets: Otis : dam site
Becket : north part of
reservoir & drainage basin

Drainage areas:
Dam: 1.322 sq. mi from project plans.
1.3 sq. mi from check

Route 20 crossing - 5000 ft. downstream from dam
add. 0.67 sq. mi
Total 1.99 sq. mi

2nd Route 20 crossing - 1500 ft. downstream from
Walker Brook junction
4.2 sq. mi.
4.2
Total 10.3 sq. mi

U-19-29
11/26/79
MOE
chk'd DHL

Indian Lake Dam

1.2 c. Size classification. (Table 1)

Top of storage = top of dam = 1480.0
Natural channel at downstream toe = 1465.3
Height 14.7'

Height < 40' is SMALL class.

Impoundment:

Bottom to normal W.L. = 256 ac. ft.
Normal W.L. to Flood W.L. = 140
346
Flood W.L. to top of Dam = 225
Maximum storage = 621 ac. ft.

Storage ≤ 1000 ac. ft. is SMALL class

V.19-29
11/5/79
MOE.
chkd DML

Indian Lake Dam
Reservoir Volume

Elev MSL	Area Ac.	h ft.	Δ Vol. Ac. ft	Cumulative Volume	Design
1465	0				0
1468	~~0~~	5 ~~4~~	39		
1470	23.4	3	104		40
1473	46.2	2	108		148
1475	"62"	2	132		256
1477	"70"	3	225		140 396
1480	80	5	435		621
1485	94				1056

V-19-24
11/5/79
MOE
Chk'd DML

Indian Lake Dam
Outlet Works capacity.

Spillway: free overfall, straight drop.

Filled for flashboards to elev. 1478.5

Fixed conc. crest elev. elev. 1473.0

Piers & sidewalls supress end contractions.

Verticle concre face acts as sharpedge weir.

Francis formula: $Q = 3.33 L H^{3/2}$; $H = (Q/3.33L)^{2/3}$

Length = 3 at 5'-4" = 16.00'

	Design max above normal W.L.	Design Max above conc. crest	Low embankment Flash boards as found	Design flood above Normal W.L.	Design Dam top above Max stoplogs	Dam top above Max stop logs	Dam top above conc. crest	Test Flood above Conc. crest	Top of dam above normal W.L.
Top	1480.0	1480.0	1478.9	1477.0	1480.0	1478.9	1478.9	1479.55	1478.9
Crest	1475.0	1473.0	1474.4	1475.0	1478.5	1478.5	1473.0	1473.0	1475.[illegible]
H (ft)	5.0	7.0	4.5	2.0	1.5	0.4	5.9	6.55	3.[illegible]
Q (cfs)	595	987.	508	140	98	13.5	265	894	410

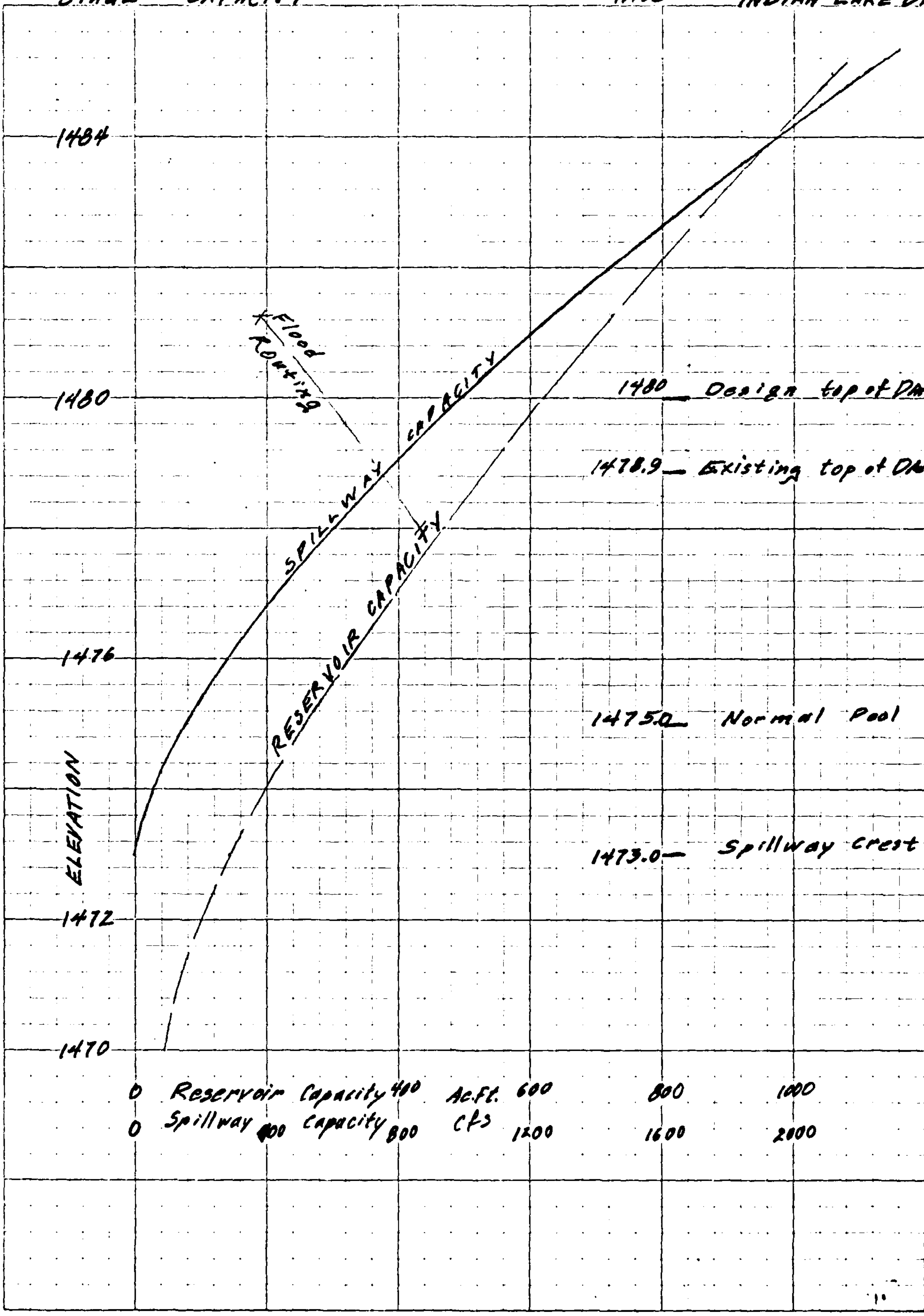
Reservoir drain: 30" x 30" sluice gate = Rodney Hunt Hy Q

Rodney Hunt formula: $Q = 0.70 A \sqrt{2gH} = 35.1 \sqrt{H}$

℄ sluice gate = 1465.6 + 2.5/2 = 1466.9

H (ft)	13.1	13.1	12.0	13.1			12.0	12.65	12.[illegible]
Q (cfs)	127	127	121	127			121	125	121
Total Q	722	1114	629	167			886	1019	531

STAGE - CAPACITY Moe INDIAN LAKE DAM



HYDROLOGIC COMPUTATIONS

MAXIMUM PROBABLE FLOOD

RESERVOIR ROUTING

Drainage area = 845 acres = 1.32 sq. mi. < 2 sq. mi.
Extrapolate MPF to 1.32 sq. mi.

Terrain is gently rolling
Good forest cover 95% to 98%
Upstream swamps 41^{+} acres.

Dam size = SMALL
Dam Hazard = more than a few = HIGH
Spillway Test Flood = ½ PMF to PMF
Use ½ PMF

$Q_{PMF/2} = \frac{1.32}{2}(2250) = 1485$ cfs.

Reduction for upstream swamps: Area = 41 Ac. at 0' depth

$STOR = \left(\frac{41+45}{2}(2')/845\right)12 = 1.2''$

$Q'_{PMF/2} = 1485\left(1 - \frac{1.2}{9.0}\right) = 1300$ cfs.

Reduce Q for good forest cover
gentle rolling slopes

say 10%

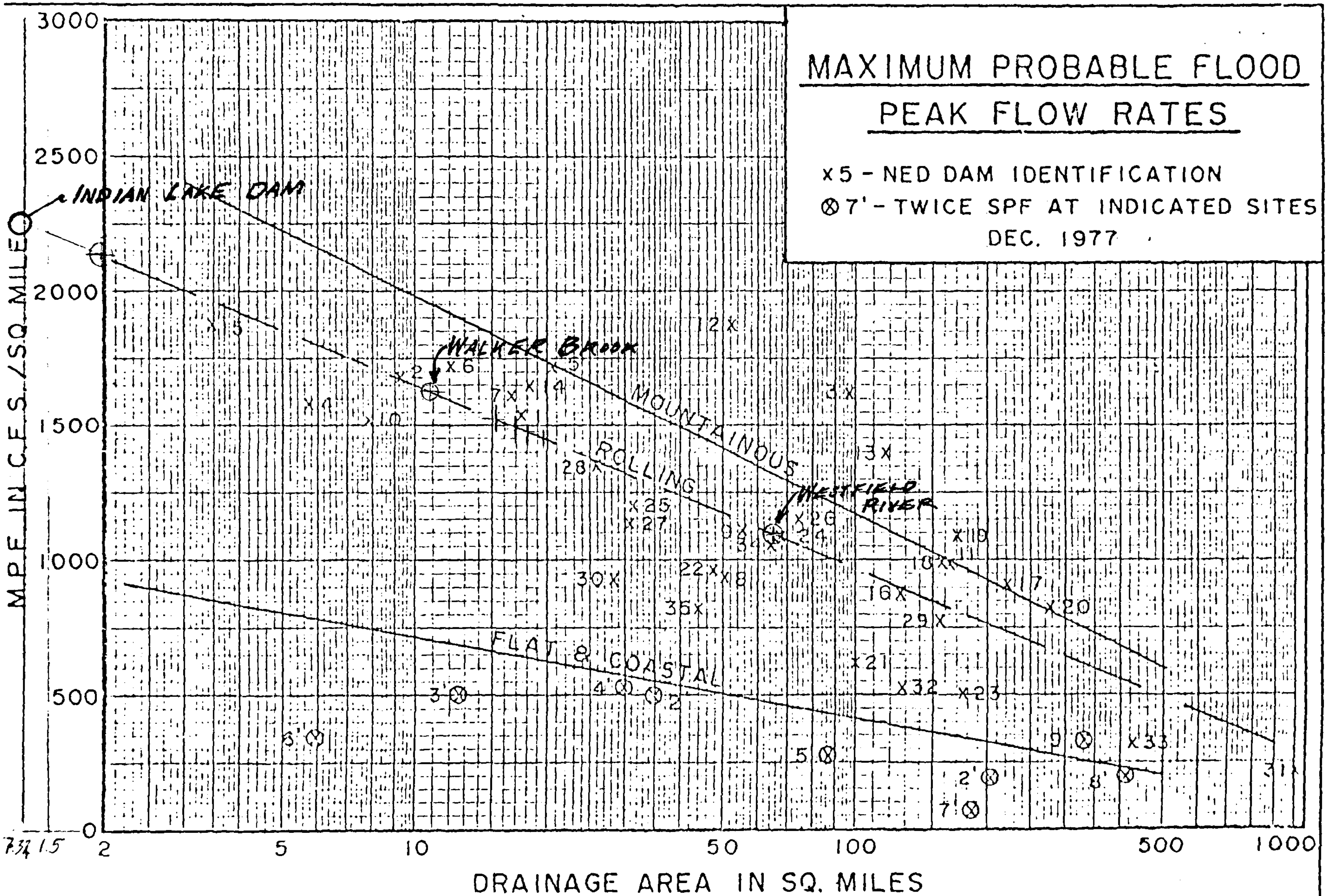
$Q''_{PMF/2} = 1300\ (.90) = 1170$ cfs. = Indian Lake Inflow

Spillway head required = $H_1 = (1170/16(3.33))^{2/3} = 7.84$

Top of Dam above spillway crest = 7.0'

Dam over topped by 0.84'

Route Spillway Test Flood thru reservoir.



MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITES
DEC. 1977
INDIAN LAKE DAM
WALKER BROOK
WESTFIELD RIVER
MOUNTAINOUS
ROLLING
FLAT & COASTAL
MPF IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES

Reservoir Routing

Assume Flood storage starts at Normal Pool

Flashboard go out; spillway capacity above Elev. 1473.0

Elev. = 1475 Reservoir capacity = 256 Ac.ft. = 3.64 in.

$Q_{p1} = 1266$ cfs

$H_1 = (1266/16(3.33))^{2/3} = 8.27'$

$$\begin{array}{r} 1473 \\ \hline \end{array}$$

Elev. = 1481.27'

Reservoir capacity = 723 Ac. ft.

$STOR_1 = \left(\frac{723-256}{845}\right)12 = 6.63$

$Q_{p2} = 1266\left(1-\frac{6.63}{9.5}\right) = 382.2$ cfs.

Try Elev. 1478

$H = 5.0'$ $Q = 596$ cfs $STOR = \left(\frac{469-256}{845}\right)12 = 3.02$ in.

$Q_{p2} = 1266\left(1-\frac{3.02}{9.5}\right) = 863$ cfs.

Try Elev. 1478.8

$H = 5.8'$ $Q = 744$ cfs $STOR = \left(\frac{528-256}{845}\right)12 = 3.86$ in.

$Q_{p2} = 1266\left(1-\frac{3.86}{9.5}\right) = 751$ cfs. $\cong$ 744 cfs

CONCLUSIONS:

Spillway and Reservoir have adequate capacity if flash boards go out early.

HYDRAULIC COMPUTATIONS

DAM FAILURE

FLOOD WAVE ROUTING

Situation at failure:

Reservoir at elevation of Spillway test Flood

Reservoir stage	Elev.=1478.8
Reservoir capacity	528 Ac.ft.
Spillway discharge	750 cfs.

Storm on watershed = 1/2 MPF

Effective on water shed below dam at runoff rate (csm) of total watershed including I.L.Dam.

Failure flow:

Breach width = 40% length at mid height − spillway

Midheight = (1480.0 + 1465.6)/2 = 1472.8

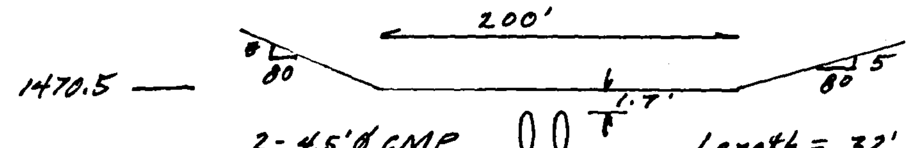
Length at Elev 1472.8 = 260'

Breach width = (260' − 27').4 = (233').4 =

Height Y_0 = 1478.8 − 1465.6 = 13.2'

$$Q_{p1} = \frac{8}{27} W_b \sqrt{g}\, Y_0^{3/2} = \frac{8}{27}(233)\sqrt{32.2}\,(13.2)^{3/2}(.40) = \underline{7515\text{ cfs}}$$

① BONNY RIGG HILL ROAD — Bridge 1



2 - 4.5' ∅ CMP
Beveled ends
Length = 32'
Inlet guard 50 % open
Allow clogging = 70 %

Culvert Flow
Assume head differential = 3.0' due to tailwater effect.

Due to clogging only entrance loss is significant

$$Q_c = (.30) A \sqrt{2gH} = .30(2)\pi\, 2.25^2 \sqrt{2g\,3.0} = 133 \text{ cfs.}$$

Flow over road
200' wide broad crested weir

$$Q_R = 3.0\ L\ H^{3/2} = 600\ H^{3/2}$$

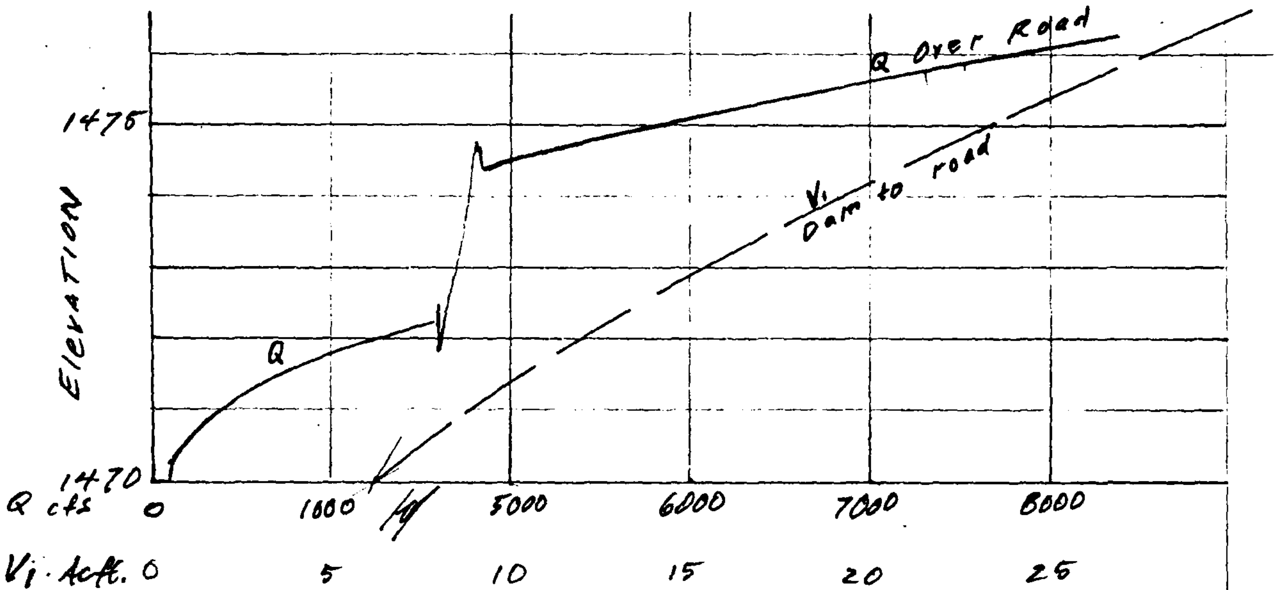
Elev	H	Q_R	Q_c	Q_T
1471.52	1.02	618	133	750
1475.0	4.5	5727	133	5860
1476.0	5.5	7739	133	7872

Valley inundation

Reach length = 600'

Elev.	Ave. width ft.	Area Ac.	V Ac ft.	
1470	180	2.5	6.25	1.25 Ac Ft/Ft
			17.25	3.45 Ac Ft/Ft.
1475	320	4.4	23.50	

① BONNY RIGG HILL ROAD



$Q_{p1} = 7515$ cfs Elev. = 1475.88 $V = 27.1$ Ac ft.

$Q_0 = 750$ cfs Elev. = 1471.52 $V = 10.6$ Ac ft.

$Q_{p2T} = (7515 - 750)\left(1 - \frac{27.1 - 10.6}{528}\right) = 6553 + 750 = 7304$ cfs.

$Q_{p2T} = 7304$ cfs Elev. = 1475.25 $V = 26.2$

$V_{ave} = \frac{27.1 + 26.2}{2} - 10.6 = 16.05$

$Q_{p2} = 750 + (7515 - 750)\left(1 - \frac{16.05}{528}\right) = 750 + 6560 = 7310$ cfs.

Elev. = 1475.75

Depth over road $= \frac{2}{3}(1475.75 - 1471.5) = 2.83$ ft

Velocity over road $= \sqrt{(2.83/2)\,g2} = 9.55$ fps.

Before dam failure

Depth over road $= (2/3)\,1.02 = 0.68$ ft

Velocity over road $= \sqrt{(.68/2)\,2g} = 4.68$ fps

(2) Route US20

Bridge 2

Typical Valley Section

Reach length = 6400 ft
$S = 210/6500 = .030$
$n = .040$

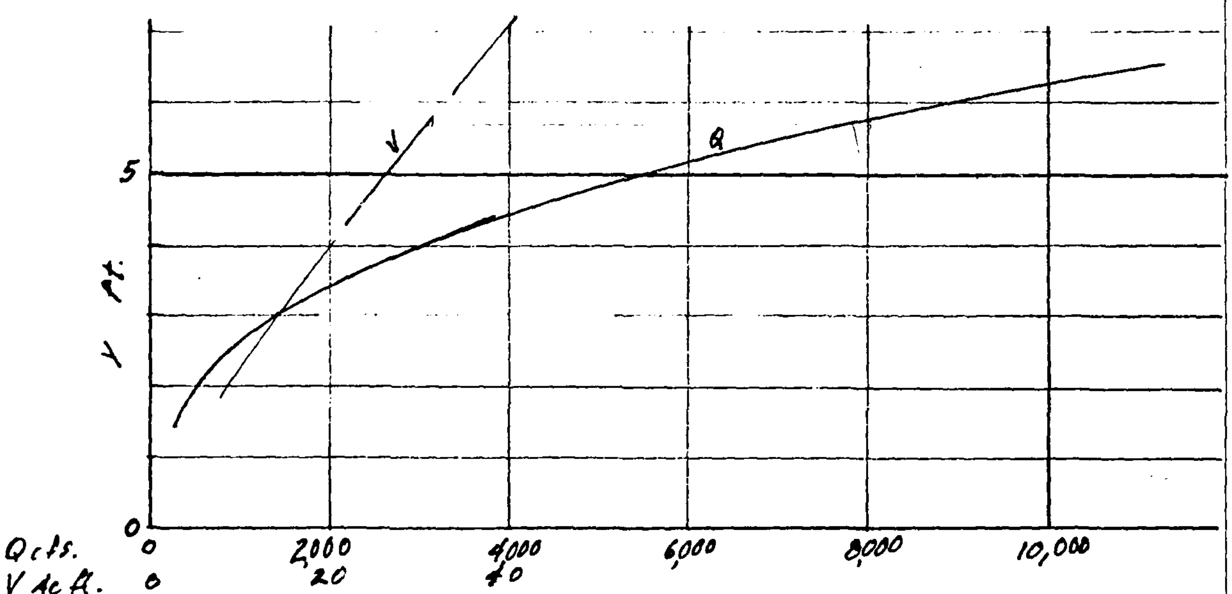
$A = 10y^2/2 + 5y + 25y^2/2 = 5y + 17.5y^2$
$P = 10.05y + 5 + 25.02y = 5 + 35.07y$
$R = A/P$

$Q = \frac{1.5}{n} AR^{2/3} S^{1/2} = 6.495 AR^{2/3}$

$y = 5'$; $A = 462.5$ □; $P = 180.35'$; $R = 2.564'$; $Q = 5{,}628$ cfs

$y = 7'$; $A = 892.5$ □; $P = 250.5$; $R = 3.563'$; $Q = 13{,}523$ cfs

$y = 2$; $A = 80$ □; $P = 75.14$; $R = 1.065'$; $Q = 542$ cfs



Valley storage: $V_r = A \frac{6400}{43560}$

y = 3'	V_r = 25.3	V_s = 7.1	V_T = 32.4
y = 5'	V_r = 67.9	V_s = 19.4	V_T = 87.3
y = 7'	V_r = 131.1	V_s = 22.8	V_T = 154.

Swamp Storage

y ft	L ft	W ft	A Ac.	V	
0	800	200	3.67 Ac		0
3	850	300	5.85	14.28	14.28
13	1000	380	8.72	72.85	87.1
5			6.42	12.27	26.5
7			7.00	13.42	39.9

② Spark Brook at U.S. Route 20 Bridge ②

Drainage Area: Dam D.A. = 845 Ac. = 1.32 Sq. Mi.

Spark Brook below dam 430 .67

1275 Ac. 1.99 Sq. Mi

MPF: Rolling terrain; 1.99 sq. mi = 2130 cfs/sq. mi.

	Before fail	After fail
Runoff below dam 0.67 (2130/2) =	714 cfs.	714 cfs.
From dam	750	7310
Total	1464 cfs	8024 cfs
		- 1464
		6560

$Q_b = 1464$ cfs; $V = 14.3$ Ac ft.

$Q_{p1} = 8024$ cfs; $V = 31.4$ Ac. ft.

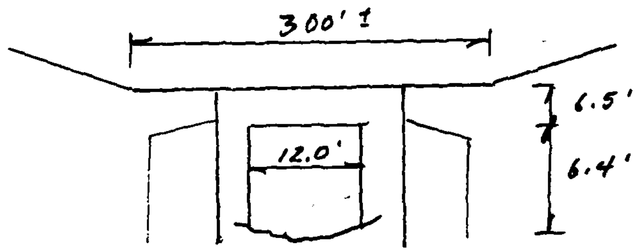
$Q_{p2T} = 7812$ cfs; $V = 30.9$ Ac. ft. $V_{AV.} = (31.4 + 30.9)/2 = 31.15$

$$Q_{p2T} = 1464 + 6560\left(1 - \frac{31.4 - 14.3}{528}\right) = 1464 + 6348 = 7812 \text{ cfs}$$

$$Q_{p2} = 1464 + 6560\left(1 - \frac{31.15 - 14.3}{528}\right) = 1464 + 6351 = 7815 \text{ cfs.}$$

② U.S. Route 20 over Spark Brook — Bridge 2

Spark Brook Bridge
12' wide box culvert
60' downstream from 4' high stone dam
No storage at dam
Culvert length = 46'



Losses = Entrance + Friction + Exit

$H = 0.5\ V^2/2g + 0.1\ V^2/2g + 0.9\ V^2/2g = 1.5\ V^2/2g$

$Q = AV = 12(6.4)\sqrt{\frac{2g(6.5)}{1.5}} = 1285$ cfs

This is the maximum culvert capacity because of tailwater rise as head water rises above road

Flow over road as a broad crested weir

$Q = 3.0\ L\ H^{3/2} = 900\ H^{3/2}$

Before failure $Q = 1464$ cfs

$H = [(1464 - 1285)/900]^{2/3} = 0.34'$

Depth of flow $= 2/3\ (0.34) = 0.23'$

Velocity $= \sqrt{2g(0.34/3)} = 2.7$ fps

After failure $Q = 7815$ cfs

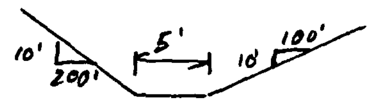
$H = [(7815 - 1285)/900]^{2/3} = 3.75'$

Depth of flow $= 2/3\ (3.75) = 2.50'$

Velocity $= \sqrt{2g(3.75/3)} = 9.0$ fps.

(2A) Spark Brook at Walker Brook

Typical Valley Section



Reach length = 1000'

$n = 0.040$

$S = 20/550 = .036$

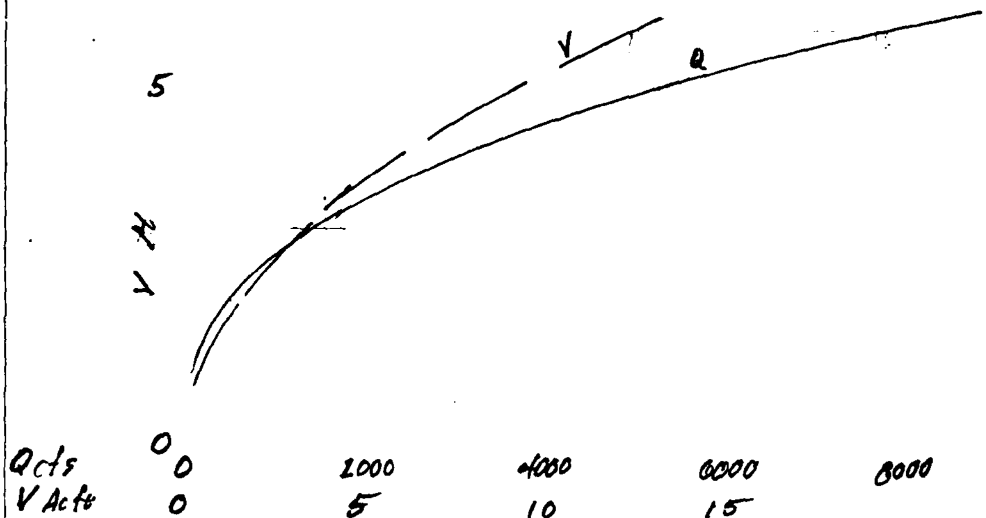
$A = 20y^2/2 + 5y + 10y^2/2 = 5y + 15y^2$
$P = 20.02y + 5 + 10.05y = 5 + 30.7y$
$R = A/P$

$Q = \frac{1.5}{n} A R^{2/3} S^{1/2} = 7.115\, A R^{2/3}$

$y = 2'$; $A = 70$ ft²; $P = 66.4'$; $R = 1.05$; $Q = 515$ cfs; $V = 1.61$ Ac.ft.

$y = 5'$; $A = 400$ ft²; $P = 158.5'$; $R = 2.524$; $Q = 5275$ cfs; $V = 9.18$ Ac.ft.

$y = 6'$; $A = 570$ ft²; $P = 189.2$; $R = 3.013$; $Q = 8,460$ cfs; $V = 13.09$ Ac.ft.



Before failure: $Q = 1464$ cfs; $V = 3.39$ Ac.ft.

After failure: $Q = 7815$ cfs; $V = 12.6$ Ac.ft.

$Q_{p2T} = 1464 + 6351\left(1 - \frac{12.6 - 3.4}{528}\right) = 1464 + 6240 = 7704$ cfs; $V = 12.5$

$Q_{p2} = 1464 + 6351\left(1 - \frac{12.55 - 3.4}{528}\right) = 1464 + 6241 = 7705$ cfs.

③ & ④ Walker Brook — Bridges 3 & 4

Drainage Area: Spark Brook below Dam 0.67 sq. mi.

Walker Brook 8.43 sq. mi.

9.10 sq. mi.

Indian Lake Dam 1.32

10.42 sq. mi.

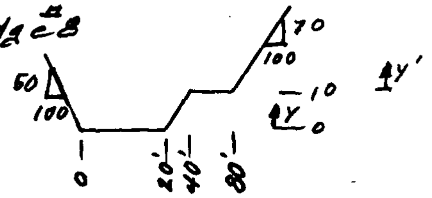
MPF: Rolling terrain; 10.42 sq. mi.; Q = 1625 csm

	Before failure	After failure
Runoff below dam 1/2 MPF 9.10 (1625/2) =	7394 cfs	7394 cfs.
From dam	750	750
		6351
	8144 cfs	14,495 cfs

Walker Brook

Typical Valley Section
From Spork Brook past bridge #8

$n = 0.060 \quad s = 50/1600 = .03'$



$Y \leq 10'$

$A = 2y^2/2 + 20y + 2y^2/2 = 20y + 2y^2$

$P = 2.24y + 20 + 2.24y = 20 + 4.47y$

$R = A/P$

$Q = \frac{1.5}{n} A R^{2/3} s^{1/2} = 4.40 A R^{2/3}$

$Y = 9;\ A = 342^{\square};\ P = 60.23';\ R = 5.68';\ Q = 4790;\ V = \frac{AL}{43560} = 39.3$ Ac.ft.

Y' Length of reach $= 13{,}000 - (7{,}000 + 1000) = 5000' = L$

$A = 2y'^2/2 + (20)10/2 + 10(20) + 10(20/2) + 40y' + 1.43y'^2/2 = 400 + 40y' + 1.71y'^2$

$P = 2.24y + 20 + 22.4 + 40 + 1.74y' = 82.4 + 3.98y'$

$R = A/P$

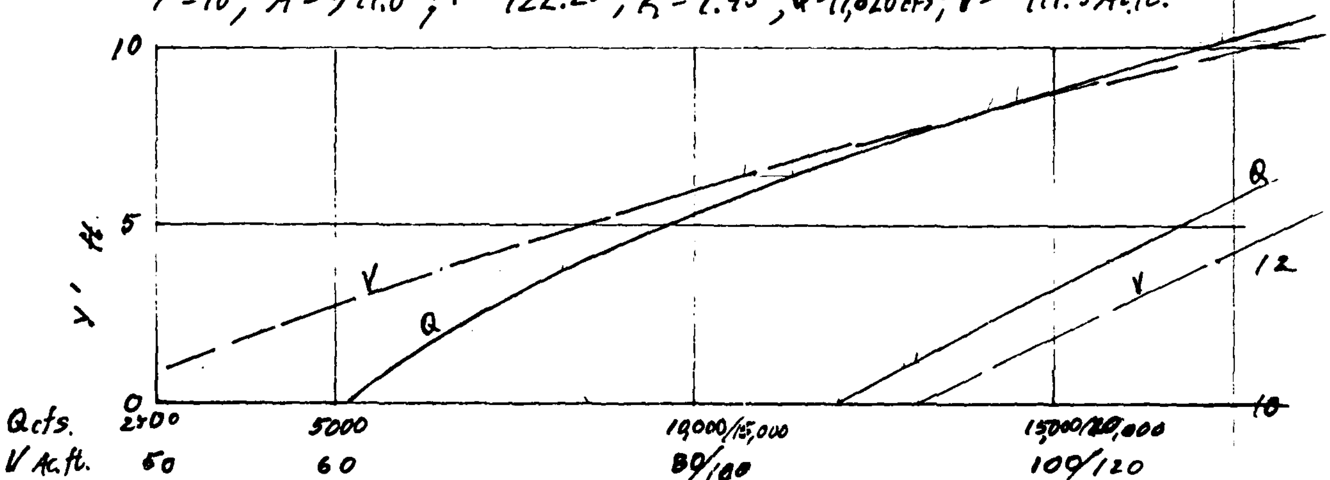
$Y' = 1';\ A = 441.7^{\square};\ P = 86.38';\ R = 5.11';\ Q = 5768$ cfs; $V =$ 50.7 Ac.ft

$Y' = 2';\ A = 486.8^{\square};\ P = 90.20';\ R = 5.40';\ Q = 6591$ cfs; $V =$ 55.9 Ac.ft.

$Y' = 5';\ A = 642.8^{\square};\ P = 102.30';\ R = 6.28';\ Q = 9630$ cfs; $V =$ 73.8 Ac.ft.

$Y' = 8';\ A = 829.4^{\square};\ P = 114.24';\ R = 7.26';\ Q = 13{,}684$ cfs; $V =$ 95.2 Ac.ft.

$Y' = 10';\ A = 971.0^{\square};\ P = 122.20';\ R = 7.95';\ Q = 17{,}020$ cfs; $V =$ 111.5 Ac.ft.



$Y' = 12;\ A = 1126^{\square};\ P = 130.2';\ R = 8.66';\ Q = 20{,}883$ cfs; $V = 129.3$ Ac.ft.

WALKER BROOK

Before failure: $Q = 8{,}144$ cfs; $V = 65.8$ Ac ft.

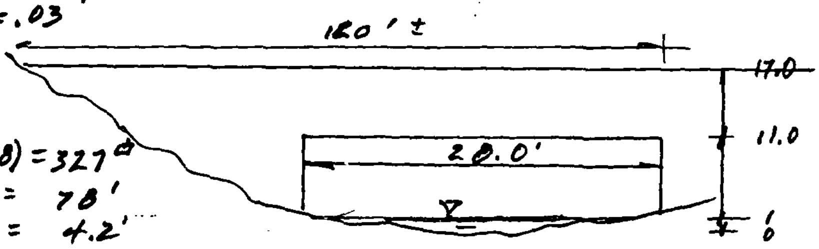
After failure: $Q = 14{,}500$ cfs.; $V = 98.2$ Ac ft.

$Q_{p2T} = 8{,}144 + 6{,}356\left(1 - \frac{98.2 - 65.8}{528}\right) = 8{,}144 + 5{,}966 = 14{,}110$ cfs; $V = 96.5$; $V_{av} = 97.4$

$Q_{p2} = 8{,}144 + 6356\left(1 - \frac{97.4 - 65.8}{528}\right) = 8{,}144 + 5{,}976 = 14{,}120$ cfs.

Route 20 Bridge 3 — Distance from dam = 10,000'
Distance from Spark Brook = 2,000'

Length of waterway = 80'
bottom slope $S = .03$
$n = .02$



$A = 11(20) + \frac{2}{3}(20) = 327^{\square}$
$P = 2(20) + 2(11) = 78'$
$R = 327/78 = 4.2'$

Loss = Entrance + Friction + Exit

$H = 0.5\,\Delta V^2/2g + 0.2\,V^2/2g + 1.0\,\Delta V^2/2g$

$= 0.5\,\frac{V_2^2 - 17^2}{64.4} + 0.2\,\frac{V_2^2}{64.4} + \frac{V_2^2 - 17^2}{64.4}$

$= V_2^2/129 - 17^2/129 + V_2^2/322 + V_2^2/64.4 - \frac{17^2}{64.4}$

$= (.00775 + .00311 + .01553)\,V_2^2 - 2.24 - 4.488$

$6.0 = .02638\,V_2^2 - 6.728$

$V^2 = \sqrt{12.728/.0264} = 22.$ fps

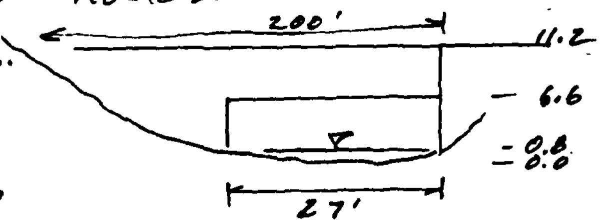
$Q = AV = 327(22) = 7182$ cfs.

Flow over Road:

Before failure $H = [(8144 - 7182)/3.0(120)]^{2/3} = 1.93'$
Depth $= \frac{2}{3}(1.93) = 1.28'$
Velocity $= \sqrt{2g(1.93/3)} = 6.4$ fps

After failure: $Q = 14{,}500 - \frac{2000}{5000}(380) = 14{,}350$ cfs
$H = [(14{,}350 - 7182)/3.0(120)]^{2/3} = 7.35'$
Depth $= \frac{2}{3}(7.35) = 4.90'$
Velocity $= \sqrt{2g(7.35/3)} = 12.6$ fps.

Walker Brook Bridge #4 Route 20



Length of waterway = 77'
bottom slope = .03'
n = .025

$A = [5.8 + 2/3(8)]27 = 171^{\square}$
$P = 27 + 2(5.9) = 38.8'$
$R = A/P = 171/38.8' = 4.4$ $V = \frac{1.5}{n} R^{2/3} S^{1/2} = \frac{1.5}{.025}(4.4)^{2/3}.03^{1/2} = 28$ fps.
$H_v = V^2/2g = 28^2/64.4 = 12.2' > 5.6' = 11.2 - 6.6$

This culvert will operate under inlet control.
Aproach velocity = Q/A = 8144/571 = 14.3 fps
Inlev velocity $V = 14.3 + \sqrt{2g(5.6/1.5)} = 14.3 + 15.5 = 29.8$ fps

$Q = AV = 171(28) = 4788$ cfs.

Flow over road

Before failure: Q = 8144 cfs

$H = [(8144 - 4788)/3.0(200)]^{2/3} = 3.15'$

Depth = 2/3 (3.15)' = 2.10'
Velocity = $\sqrt{2g(3.15/3)}$ = 8.2 fps

After failure: Q = 14,120 cfs

$H = [(14,120 - 4788)/3.0(200)]^{2/3} = 6.23'$

Depth = 2/3 (6.23) = 4.15'
Velocity = $\sqrt{2g(6.23/3)}$ = 11.6 fps

Walker Brook Route 20 at Bridge #5

Drainage area:	Spark Brook	0.67 sq.mi.
	Walker Brook	8.43
	Walker Brook above Bridge #5	4.88
		13.98 sq.mi.
	Indian Lake Dam	1.32
		15.30 sq.mi

M.P.F. Rolling terain; 15.3 sq.mi; Q: 1520 csm.

	Before failure	After failure
Runoff below dam ½ MPF 13.98(1520/2) =	10,625 cfs	10,625 cfs
From dam	750	750
		5,976
Total flow Q_{p1} =	11,375 cfs	17,351 cfs

Before failure: $Q = 11{,}375\,cfs$; $V = 82.7 \frac{3000}{5000} = 49.6$ Ac.ft.

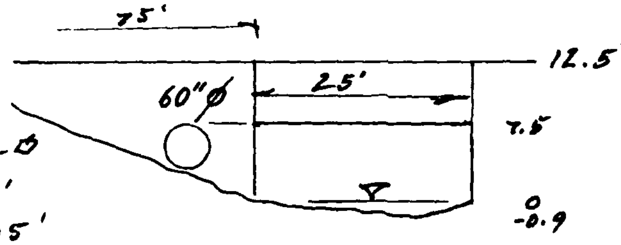
After failure: $Q = 17{,}350\,cfs$; $V = 113.0 \frac{3000}{5000} = 67.8$ Ac.ft.

$Q_{p2T} = 11{,}375 + 5976\left(1 - \frac{67.8 - 49.6}{528}\right) = 11{,}375 + 5770 = 17{,}145\,cfs.$

$V = 111.5 \frac{3000}{5000} = 67.8$ Ac.ft.; $V_{ave} = 67.8$

Bridge #5, Route 20 over Walker Brook

Water way length = 71.5'
$S = .03$ $n = .025$



$A = 25(7.5 + \frac{2}{3}(0.9)) = 202.5^{\square}$
$P = 25.1 + 2(7.5) = 40.1'$
$R = A/p = 202.5/40.1 = 5.05'$
$V = \frac{1.5}{n} R^{2/3} S^{1/2} = 30.6$ fps

Check for inlet control : $H = 5.0'$
$H = 1.5 \frac{V_2^2 - V_1^2}{2g}$ $V = 14 + \sqrt{\frac{2g\,5.0}{1.5}} = 14 + 6.8 = 20.8$ fps
$Q = AV = 202.5(20.8) = 4212$ cfs.

60" RCP
$n = .013$
$S = .03$
$V = 20$ fps
$Q = 400$ cfs

Flow over Road:

Before failure: $Q = 11,375$ cfs
$H = [(11,375 - \cancel{4,212}\ 4600)/3.0(75)]^{2/3} = \cancel{10.0}'\ 9.7'$
Depth = $\frac{2}{3}(\cancel{10.0}\ 9.7) = \cancel{6.7}'\ 6.5'$
Velocity = $\sqrt{2g(\cancel{10.0}\ 9.7/3)} = \cancel{14.6}$ fps. 14.4 fps

After failure: $Q = 17,145$ cfs
$H = [(17,145 - \cancel{4212}\ 4600)/3.0(90)]^{2/3} = \cancel{13.2}'\ 12.9'$
Depth = $\frac{2}{3} H = \frac{2}{3}(\cancel{13.2}\ 12.9) = \cancel{8.8}'\ 8.6'$
Velocity = $\sqrt{2g(13.2/3)} = \cancel{16.8}$ fps. 16.7 fps

Bridge #6 Blandford Road over Walker Brook

Failure wave attenuation:

Before failure: Reach flow Q = 11,375 cfs; $V = 82.7\left(\frac{3000}{5000}\right) = 49.6$ Ac.ft

After failure: Reach flow Q = 17,145 cfs; $V = 111.5\left(\frac{3010}{5000}\right) = 66.9$ Ac.ft

$Q_{p27} = 11{,}375 + 5770\left(1 - \frac{66.9 - 49.6}{528}\right) = 11{,}375 + 5{,}580 = 16{,}955$ cfs.

$V = 111.2 \frac{3000}{5000} = 66.7$ $V_{AVE} = \frac{66.9 + 66.7}{2} = 66.8$

Flows at Bridge #6

Drainage Area: D.A. Bridge 5	13.98 sq. mi.
Bridge 5 to 6 D.A. =	1.68
	15.66 sq. mi.
Indian Lake Dam. D.A. =	1.32
	16.98 sq. mi

M.P.F. Rolling terain 16.98 sq. mi.; Q = 1498 csm

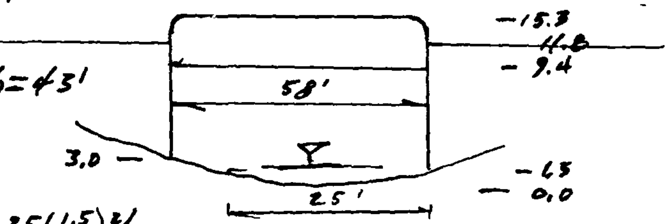
	Before failure	After failure
Runoff below Dam ½ MPF 15.66 (1498/2) =	11,730 cfs.	11,730 cfs
From dam	750	750
		5,580
Total flow Q =	12,480 cfs	18,060 cfs.

Blandford Road Bridge over Walker Brook Bridge

Waterway length = 36'

Bridge abutment length = 43'

$S = .03$; $n = .025$



$A = 58(6.4) + \frac{58+25}{2}(1.5) + 25(1.5)^{2/3}$

$= 458^{\square}$

$P = 58.2 + 7.9 + 6.4 = 72.50'$; $R = A/P = 6.32'$

Assume bridge will operate under inlet control

$V = 14. + \sqrt{2g(2.4/1.5)} = 14. + 10.1 = 25$ fps.

$Q = AV = 458(25) = 11,450$ cfs.

Flow over Road:

Before failure:

$H = [(12,480 - 11,450)/3.0(100)]^{2/3} = 2.3'$

Depth $= 2/3(2.3) = 1.5'$

Velocity $= \sqrt{2g(2.3/3)} = 7.0$ fps.

After failure:

$H = [(18,060 - 11,450)/3.0(100)]^{2/3} = 7.8'$

Depth $= 2/3(7.8) = 5.2'$

Velocity $= \sqrt{2g(7.8/3)} = 13.0$ fps

Failure wave attenuation to Hazard Area #7

Before failure: $Q = 12,480$ cfs ; $V = 91.3 \frac{3000}{5000} = 54.8$ Ac-ft.

Reach length = 3000'

After failure: $Q = 18,060$ cfs ; $V = 117.1 \frac{3000}{5000} = 70.3$ Ac-ft.

$$Q_{p27} = 12,480 + 5,580\left(1 - \frac{70.3 - 54.8}{528}\right) = 12,480 + 5,416 = 17,896 \text{ cfs}$$

$$V = 116.6\left(\frac{3000}{5000}\right) = 70.0 \text{ Ac.ft.} ; V_{Av} = (70.3 + 70.0)/2 = 70.1 \text{ Ac ft}$$

$$Q_{P2} = 12,480 + 5,580\left(1 - \frac{70.1 - 54.8}{528}\right) = 12,480 + 5,418 = 17,898 \text{ cfs.}$$

Flows at Area #7 : D.A. at Bridge #6 = 15.66 sq. mi.
#6 to #7 D.A. = 1.01
16.67 sq. mi.
Indian Lake Dam D.A. = 1.32
17.99 sq. mi.

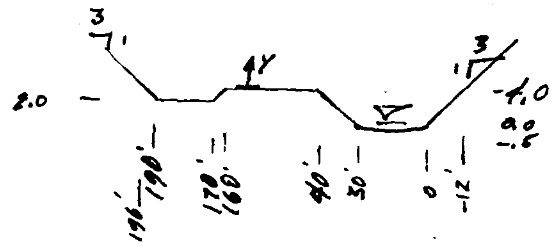
M.P.F. Rolling terrain 17.99 sq. mi.; Q = 1475 csm

	Before failure	After failure
Runoff below dam 1/2 MPF 16.67 (1475/2) =	12,294	12,294
From dam	750	750
		5,420
Total flow Q =	13,044 cfs	18,464 cfs.

WALKER ISLAND CAMP GROUND

Hazard Area # 7

$S = .03$; $n = .04$



$A = 6(2/2) + 2(20) + 10(2/2)$
$+ 10(4/2) + 30(4) + 4(3/2)4$
$+ 208y + 3y^2/2 + 3y^2/2$

$= 210 + 208y + 3y^2$

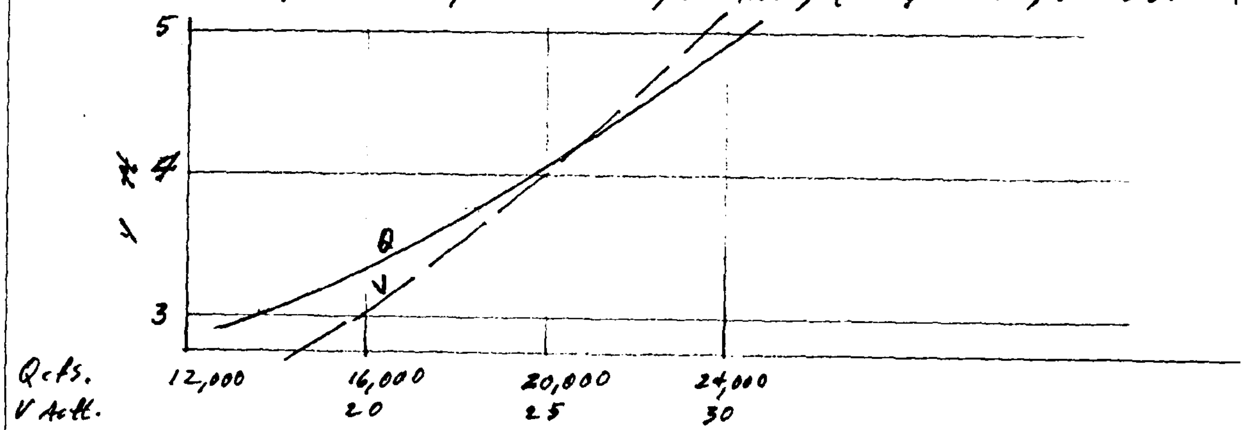
$P = 208.3 + 2(3.15y) = 208.3 + 6.3y$; $R = A/P$; Reach length = 1000'

$y = 6'$; $A = 1250^{\square}$; $P = 239.8$; $R = 5.21'$; $Q = 24,429$ cfs; $V = 28.7$ Ac ft.

$Q = \frac{1.5}{n} A R^{2/3} S^{1/2} = \frac{1.5}{.04} .03^{1/2} A R^{2/3} = 6.50 A R^{2/3}$; $V = AL/43560$ Ac ft.

$Y = 3$; $A = 861^{\square}$; $P = 227.2'$; $R = 3.79$; $Q = 13,603$ cfs; $V = 19.8$ Ac ft.

$Y = 4$; $A = 1090^{\square}$; $P = 233.5'$; $R = 4.67'$; $Q = 19,790$ cfs; $V = 25.0$ Ac ft.



Before failure $Q = 13,044$ cfs; $Y = 2.9'$; $V = 19.3$ Ac ft.

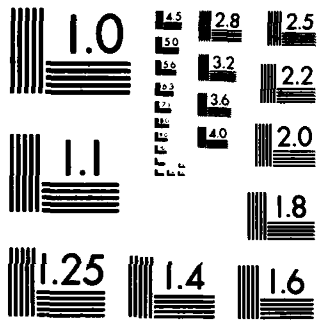
After failure $Q = 18,464$ cfs; $Y = 3.78'$; $V = 23.4$ Ac ft.

$Q_{P2} = 13044 + 5,420\left(1 - \frac{23.4 - 19.3}{528}\right) = 13,044 + 5378 = 18,422$ cfs; $V = 23.4$ Ac ft.

$V_{Ave} = (23.4 + 23.4)/2 = 23.4$ Ac ft $= 23.4$ Ac ft.

AD-A155 635 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS INDIAN LAKE DAM (MA 0..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV DEC 79 2/2

UNCLASSIFIED F/G 13/13 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Town Road over Walker Brook Bridge #8

Dam breake wave attenuation to Bridge #8

Before failure: $Q = 13{,}044$ cfs; $V = 90.8\,\frac{2000}{5000} = 36.3$ ac-ft.

Reach length = 2000' from end of Hazard Area #7 to Bridge #8

After failure: $Q = 18{,}422$ cfs; $V = 118.8\,\frac{2000}{5000} = 47.5$ ac-ft.

$Q_{P2T} = 13{,}044 + 5{,}378\left(1 - \frac{47.5-36.3}{528}\right) = 13{,}044 + 5264 = 18{,}308$ cfs

$V = 118.2\left(\frac{2000}{5000}\right) = 47.2$; $V_{AVE} = (47.5+47.2)/2 = 47.4 \cong 47.5$

Flows at Bridge #8 : D.A. @ #7 = 16.67 sq. mi.
D.A. #7 to #8 1.65
D.A. below dam = 18.32 sq. mi.
Indian Lake Dam 1.32
Total Area 19.64 sq. mi.

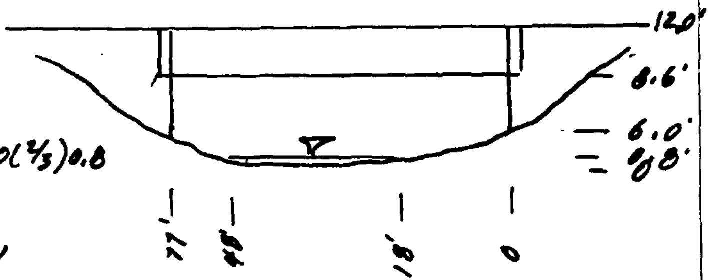
M.P.F. Rolling Terrain; D.A. = 19.64 sq. mi; Q = 1450 csm.

Runoff below Dam = 1/2 MPF

	Before failure	After failure
18.32 (1450/2) =	13,282	13,282
From dam	750	750
		5,264
Total flow Q =	14,032 cfs	19,296 cfs.

Town Road over Walker Brook Bridge #8

Bridge width = 14.2'
Abutment length = 18' ±
S = .03 ; n = 0.05



$A = 77(2.6) + \frac{77+30}{2}(5.2) + 30(\frac{2}{3})0.8$
$= 494.4^{ft^2}$

Assume inlet control

$V = 14 + \sqrt{2g\ 3.4/1.5} = 14 + 12.1 = 26.1$ fps.

$Q = VA = 26\ (494) = 12,844$ cfs.

Flow over Road:

Before failure $Q = 14,032$ cfs

$H = [(14,032 - 12,844)/3.0(100)]^{2/3} = 2.5'$

Depth $= \frac{2}{3}(2.5) = 1.7'$

Velocity $= \sqrt{2g(2.5/3)} = 7.3$ fps.

After failure $Q = 19,300$ cfs

$H = [(19,300 - 12,850)/3.0(100)]^{2/3} = 7.73'$

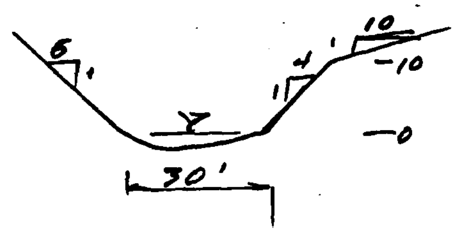
Depth $= \frac{2}{3}(7.73) = 5.2'$

Velocity $= \sqrt{2g\ (7.73/3)} = 12.9$ fps.

Bridge #8 to Bridge #9

Reach length = 13,000'

$S = 50/2100' = .024; n = .04$



$Y \leq 10'$

$A = 6Y^2/2 + 30Y + 4Y^2/2 = 30Y + 5Y^2$

$P = 6.08Y + 30 + 4.12Y = 30 + 10.2Y$

$R = A/P$; $Q = \frac{1.5}{n} A R^{2/3} S^{1/2} = 5.81 A R^{2/3}$

$Y = 10'$; $A = 800^{\square}$; $P = 132'$; $R = 6.06'$; $Q = 15,450$ cfs; $V = 239$ Ac.ft.

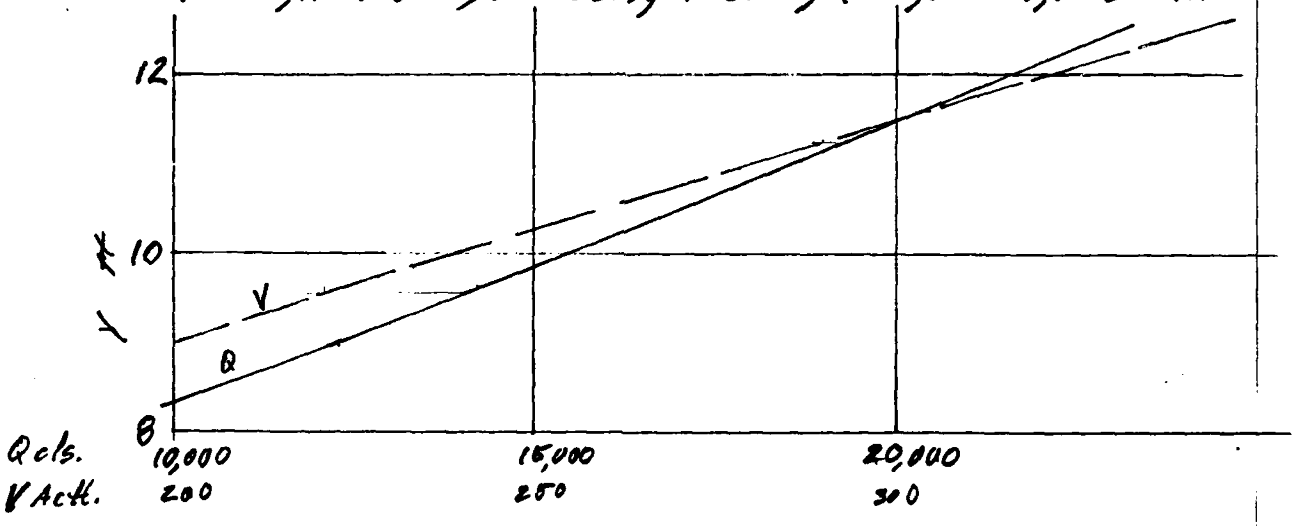
$Y = 9'$; $A = 675^{\square}$; $P = 121.8'$; $R = 5.54'$; $Q = 12,232$ cfs; $V = 201$ Ac.ft.

$Y' = Y - 10'$

$A = 60(10/2) + 30(10) + 40(10/2) + 130Y' + 10Y'^2/2 = 800 + 130Y' + 5Y'^2$

$P = 132 + 6.08Y + 10.05Y = 132 + 18.13Y$

$Y' = 2'$; $A = 1080^{\square}$; $P = 168.3$; $R = 6.42'$; $Q = 21,672$ cfs; $V = 322$ Ac.ft.



Before failure: $Q = 14,032$ cfs; $V = 221$ Ac.ft.

After failure: $Q = 19,300$ cfs; $V = 290$ Ac.ft.

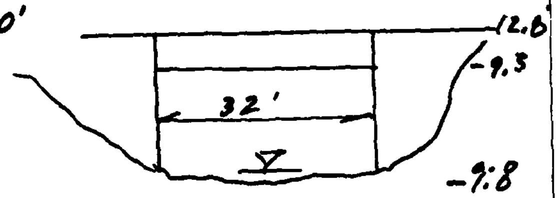
$Q_{p2T} = 14,032 + 5268\left(1 - \frac{290 - 221}{528}\right) = 14,032 + 4580 = 18,612$ cfs; $V = 271$

$V_{ave} = \frac{290 + 271}{2} = 280.5$

$Q_{p2} = 14,032 + 5268\left(1 - \frac{280.5 - 221}{528}\right) = 14,032 + 4675 = 18,707$ cfs.

Route US 20 over Walker Brook in Chester Bridge # 9

Waterway length, Average = 60'



$n = .03$

Assume bridge will operate under inlet control

Entrance loss with 45° wingwalls = $0.2V^2/2g$

$A = 32(9.3) + 32(2/3) = 320^{\square}$

$V = V_1 + \sqrt{2g(3.5/1.2)} = V_1 + 13.7$

At $Q = 14{,}030$ cfs; $V_1 = 18.7$ fps. Bridge capacity $= Q = AV$

$Q_{bdg} = 320(32.4) = 10{,}370$ cfs.

At $Q = 18{,}700$ cfs; $V_1 = 20.6$ fps.

$Q_{bdg} = 320(34.3) = 10{,}976$ cfs.

Flow over road: Before failure

$H = [(14{,}032 - 10{,}370)/3.0(150)]^{2/3} = 4.04'$

Depth $= 2/3(4.04) = 2.7'$

Velocity $= \sqrt{2g(4.04/3)} = 9.3$ fps.

After failure

$H = [(18{,}710 - 10{,}980)/3(150)]^{2/3} = 6.66'$

Depth $= 2/3(6.66) = 4.44'$

Velocity $= \sqrt{2g(6.66/3)} = 12.0$ fps.

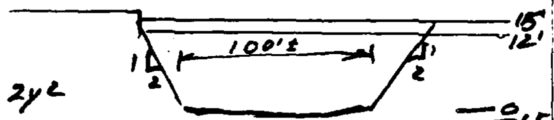
Westfield River in Chester, Mass

Drainage area = 64.7± sq. mi.

M.P.F. Rolling terrain; 64.7 sq. mi; Q = 1090 csm

		Before failure	After failure
Runoff	$= (64.7-1.3)1090/2 =$	34,553 cfs.	34,553 cfs.
From dam		750	750
			4,675
Total flow.		35,303 cfs.	39,978 cfs.

channel slope: $30/3000 = .010$; $n = .035$



$A = 2y^2/2 + 100'y + 2y^2/2 = 100y + 2y^2$
$P = 2.24y + 100 + 2.24y = 100 + 4.48y$

$Y = 12'$; $A = 1488^{\square}$; $P = 153.8$; $R = 9.68$; $Q = 29{,}000$ cfs.

$V = V_1 + \sqrt{2g(3/1.2)} = V_1 + 12.7$ fps.

$Q = AV = 1500(12.7 + 19.5) = 48{,}300$ cfs. = bridge capacity.

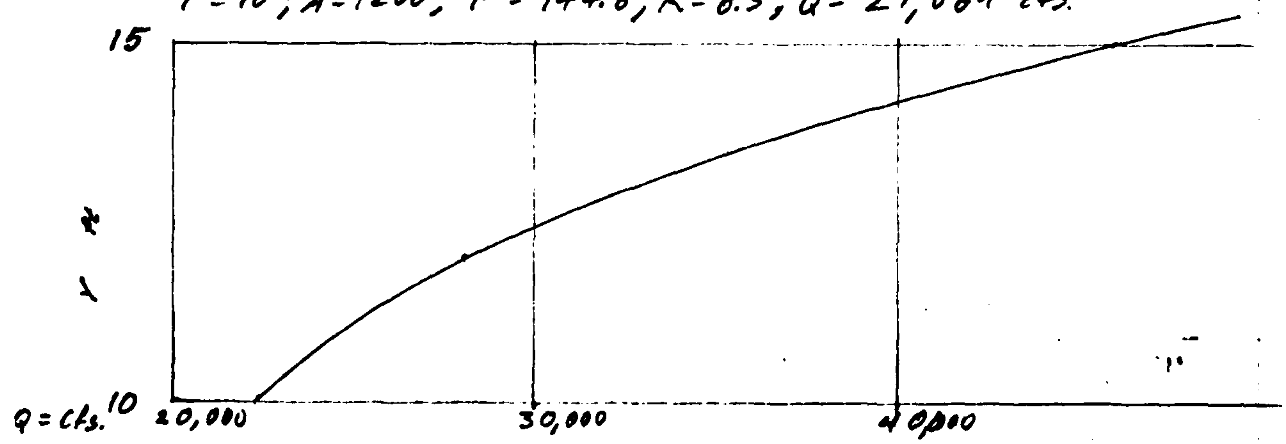
Channel capacity:

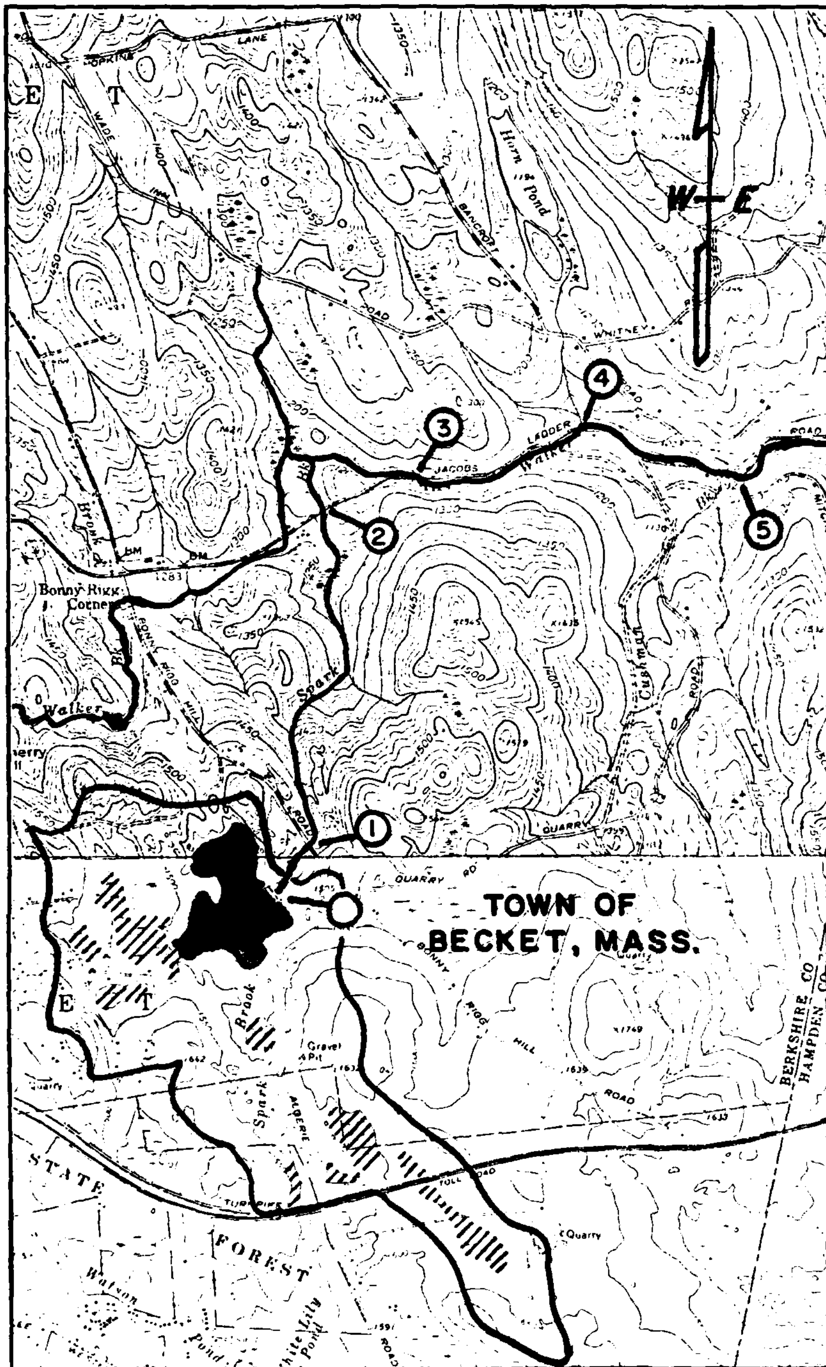
$Y = 15'$; $A = 1950^{\square}$; $P = 167.2$; $R = 11.67$;

$Q = 1.5/0.035 \, A R^{2/3} S^{1/2} = 42{,}980$ cfs.

Conclusions: This river channel & bridge is adequate for ½ MPF + dam failure flood wave.

$Y = 10'$; $A = 1200$; $P = 144.8$; $R = 8.3$; $Q = 21{,}084$ cfs.





: DAM
① : 600' D.S. BONNY RIGG RD.
② : 7,000' D.S. ROUTE 20
③ : 10,000' D.S. ROUTE 20
④ : 13,000' D.S. ROUTE 20
⑤ : 16,000' D.S. ROUTE 20
⑥ : 19,000' D.S. ROUTE 20
⑦ : 22,000 D.S. CAMP GROUND
⑧ : 25,000 D.S. TOWN ROAD
⑨ : 38,000 D.S. ROUTE 20
CONFLUENCE WITH THE WEST BRANCH OF THE WESTFIELD RIVER

– SCALE –

1000' 0' 1000' 2000' 3000' 4000'

FROM USGS OTIS BECKET CHESTER

DRAINAGE AREA

DAMAGE CENTER ①

SWAMPS

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

INDIAN LAKE DAM (MA01051) BECKET
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: AS NOTED
DATE: DECEMBER 1979

FLOOD EXPERIENCE

Reference: U.S.G.S. Water Supply Paper 1420
"Floods of August-October 1955"

Station	D.A.	cfs/mi^2	cfs	Flow Duration Days	Runoff ft^3	ac.ft.	in
Skyes Brook, Knightville	1.64	415	680	0.50	14.688×10^6	337	3.86
Walker Brook, Chester	17.7	295	5,220				
Stage Brook, Russell	5.21	942	4,910				
Potash Brook, Blandford	1.53	791	1,210				
Powermill Brook, Westfield	2.50	2,300	5,740				
Arithmetic Average		989					
Totals	28.58		17,760				
Weighted Average		621					

When applied to Indian Lake dam the following results:

Station	D.A.	cfs/mi^2	cfs	Flow Duration Days	Runoff ft^3	ac.ft.	in
Indian Lake, Becket	1.32	1,072	1,415	(design data underlined)			
	1.32	415	548		11.855×10^6	273	3.86

(applicable Sykes Brook data underlined)

Based on the 1955 flood report data, the design inflow peak and outflow peak are not unreasonable, but might be exceeded under some conditions.

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
MA	1051	NED	MA	003	01				INDIAN LAKE DAM	4214.9	7301.5	03JAN80

POPULAR NAME	NAME OF IMPOUNDMENT
	INDIAN LAKE

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	08	SPARKS BROOK	CHESTER	0	

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	NORMAL (ACRE-FT.)
REPG	1975	R	15	15	539	256

DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
NED	N	N	N	N	

REMARKS

D/S HAS	SPILLWAY CREST LENGTH	TYPE	WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	PROPOSED (MW)	NO	NAVIGATION LOCKS LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	460	U	16	395												

OWNER	ENGINEERING BY	CONSTRUCTION BY
COMMUNITY SAVINGS BANK	BARNES + JARNIS	ANDREWS CONSTRUCTION

REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
TIGH +BOND /SCI	31OCT79	PL-92-367

REMARKS

END

FILMED

7-85

DTIC